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ABSTRACT

These units of instructional materials and teaching aids are the final three of a series of eight designed for use in rural agriculture programs for students in grades 9 and 10. Covered in the unit on soil science and conservation of natural resources are collecting soil samples and applying soil sample test results. Growing vegetables and beautifying the homestead are examined. Discussed next are such aspects of agricultural mechanics as identifying, fitting, and using hand tools; using selected power tools; developing safe work habits in agricultural mechanics; and developing basic carpentry skills. Each of these units or problem area packets includes some or all of the following components: suggestions to the teacher, a content outline, a teacher's guide, information sheets, student worksheets or assignment sheets and keys, demonstrations, job sheets, transparencies, a discussion guide for the transparencies, and sample test questions and a teacher's key. (The remaining units are available separately--see note.) (MN)

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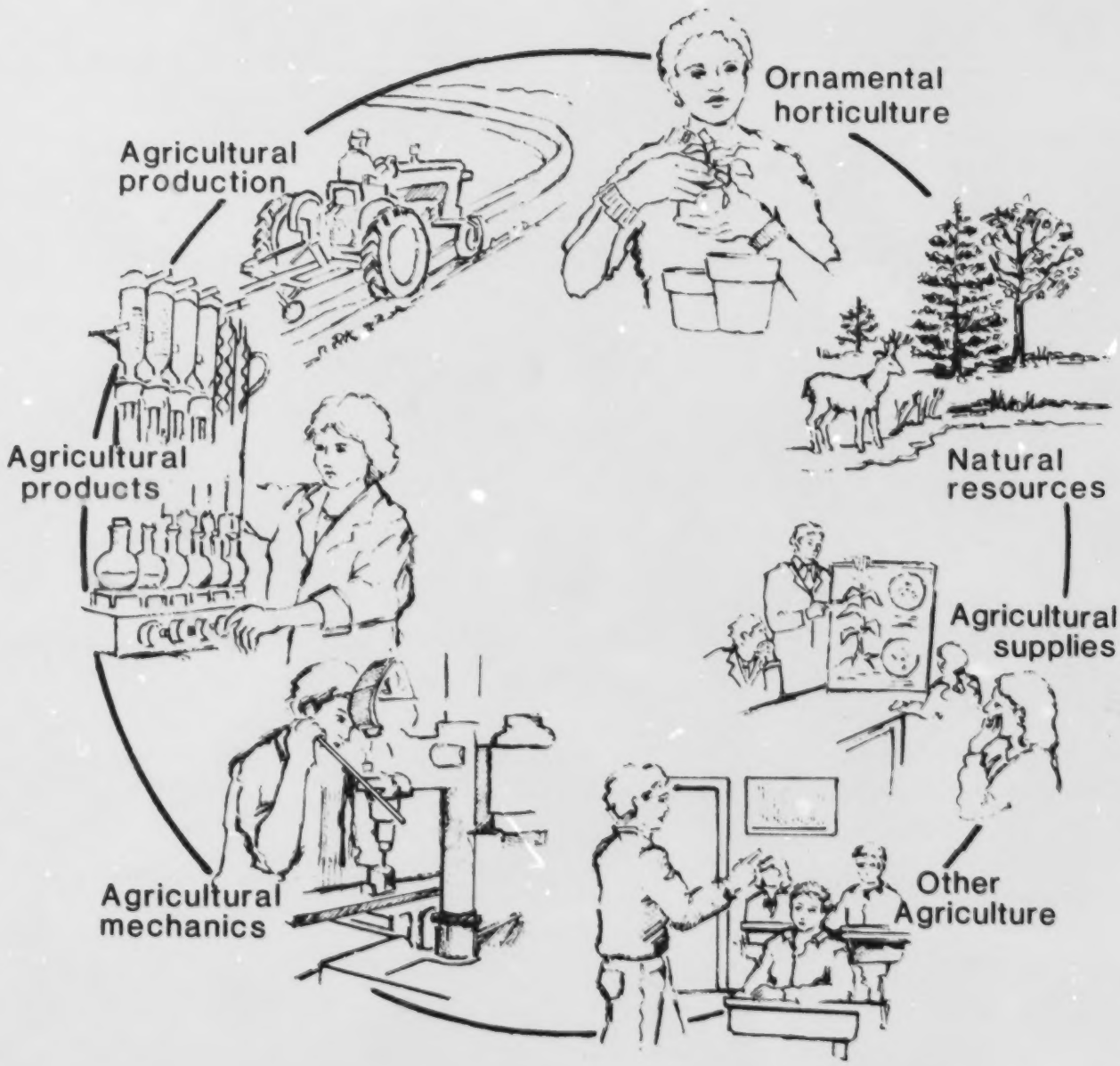
**Core I Materials for Rural Agriculture Programs**

**Illinois State Board of Education**

Adult Vocational and Technical Education

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CE 030 179

UNIT F: Soil Science and Conservation of Natural Resources

PROBLEM AREAS:

1. Collecting soil samples
2. Applying soil sample test results

## UNIT F: SOIL SCIENCE AND CONSERVATION OF NATURAL RESOURCES

## PROBLEM AREA: COLLECTING SOIL SAMPLES

### SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with ninth grade or beginning students enrolled in an agricultural occupations program. The recommended time for teaching this problem area is during the fall semester before the soil freezes. The estimated time for teaching this problem area is 1 to 3 days depending on how much time the teacher wishes to spend on discussion and conducting the suggested exercises. The materials in this problem area were selected and written with the following assumptions:

1. That all students need to understand the method of collecting a soil sample.
2. That each student will have the opportunity to collect a sample from his/her own S.O.E.P.

The instructor is encouraged to conduct a local search to locate other supplementary materials. The items in this problem area are for reference or modification as the teacher adapts these materials to his/her local situation.

### CREDIT SOURCES:

These materials were developed through a funding agreement, R-33-21-D-0542-388 with the Illinois State Board of Education, Department of Adult, Vocational and Technical Education, Research and Development Section, 100 North First Street, Springfield, Illinois 62777. Opinions expressed in these materials do not reflect, nor should they be construed as policy or opinion of the State Board of Education or its staff.

The teacher's guide, worksheets, and sample test questions were developed by Jerry Pepple, Department of Vocational and Technical Education, University of Illinois. The transparency masters and transparency discussion guides were prepared by Vocational Agriculture Service, University of Illinois. The information sheets "Soil Testing Services in Illinois," and the recommended procedures presented are those proposed by the Department of Agronomy and the Cooperative Extension Service of University of Illinois. Suggestions and guidance in the development of these materials were provided by the Rural Core Curriculum Pilot Test Teachers.

## TEACHER'S GUIDE

I. Unit: Soil science and conservation of natural resources

II. Problem area: Collecting soil samples

III. Objectives: At the close of this problem area students will:

1. Know the materials needed for sampling soil.
2. Understand the steps to follow in sampling soil.
3. Know the recommended number of samples to take in fields, lawns, gardens, and flower beds.

IV. Suggested interest approaches:

1. Lead a discussion on soil sampling by asking students if they have ever taken soil samples.
2. Take the class on a field trip to a soil testing laboratory.
3. Have a local fertilizer dealer as a guest speaker to discuss the importance of proper soil fertility.

V. Anticipated problems and concerns of students:

1. Why do we take a soil sample?
2. What factors influence the number of samples to be taken?
3. What is the procedure to follow in taking a good soil sample?
4. How are the samples correctly prepared and packaged for testing or sending to a laboratory
5. Why is information about past history and yield included with the samples?
6. When and how often should a soil sample be taken?
7. What are some things to avoid when taking a soil sample?
8. What soil testing services are locally available and is there a charge?
9. How do I take soil samples from greenhouse bench crops, nursery and greenhouse potted crops, and plants in the home?

VI. Suggested learning activities and experiences:

1. Have class read VAS Unit 4001 and record tentative answers to the problems and concerns identified by the class and instructor.
2. Distribute Soil Science Worksheet 1 and have students complete the blanks.

3. Show transparencies 1–11.

   a. Following instructions and sampling tools.
   b. Watching for unusual areas.
   c. Taking samples from each area.

4. Distribute the soil test report forms.

5. Show transparencies 12–14.

   a. Completing the information sheet.
   b. Follow test recommendations.

6. Distribute soil sample information sheet for lawns, gardens, and flower beds.

7. Discuss important facts concerning soil sampling from lawns, gardens, and flower beds.

8. Discuss how to complete Form B, using the Sample Form as an example.

9. Take students on a field trip to collect soil samples or make this an out-of-class assignment. Use Job Sheet 1.

VII. Application procedures:

1. Have each student take soil samples from his home, greenhouse, or houseplants for testing.

2. The interpretation of the soil tests will be emphasized in the problem area, "Applying Soil Sample Test Results."

VIII. Evaluation:

1. Prepare and administer a pencil and paper test using the Sample Test Questions as possible test items.

2. Collect and grade Soil Science Worksheet 1.

3. Give credit for bringing soil samples from home for testing.

4. Have students demonstrate how to collect a soil sample and prepare it for testing.

IX. References and aids:

1. VAS Unit 4001, Vocational Agriculture Service, University of Illinois.

2. Soil Testing and Fertility Transparencies and Study Guide, Vocational Agriculture Service, University of Illinois.

3. Soil Test Report Forms A and B, Vocational Agriculture Service, University of Illinois.

4. Soil Test Report Form B, Completed Example.

5. Soil Test Procedures for lawns, gardens, flower beds, and greenhouse soils.

6. Soil Science Worksheet 1 and Job Sheet 1.

7. Hand out on Soil Testing Services in Illinois.

8. Supplies and tools:

   a. Supply of small paper sacks.
   b. Box of basket for carrying the samples.
   c. Pan or bucket for mixing the samples.
   d. Trowel, spade, soil probe or auger to dig the samples

9. Sample Test Questions.

## INFORMATION SHEET

## SOIL TESTING SERVICES IN ILLINOIS

In response to inquiries about the location of soil testing services in different parts of Illinois, an information sheet listing soil testing laboratories is included in this problem area. These laboratories submitted soil samples for check testing to the Department of Agronomy, University of Illinois during the past year.

Reliable soil tests provide a valuable service to the people of Illinois. The soil testing program in Illinois is a decentralized service provided by local laboratories. The program is not rigidly regulated by any agency, but acquires direction from the Department of Agronomy and the Cooperative Extension Service of the University of Illinois and the Agricultural Stabilization and Conservation Service. These agencies are interested in helping to assure accurate soil tests, valid interpretation of these tests, and practical recommendations for soil treatments to Illinois farmers.

All agencies interested in the soil testing program agree that all soil testing laboratories in Illinois should meet the following minimum standards.

1. The standard of taking and testing 11 soil samples per 40 acres has been established. Although it may not be practical to adhere rigidly to this standard, one sample for every three to four acres should be used as a guide, depending on the soil type variations in any field.

2. A recommended soil treatment should be based on both an interpretation of the soil test results and a knowledge of the field history (cropping and treatment). Laboratories should either refuse samples that are not accompanied by a field history form or should return the results of the soil tests with the notation "Insufficient information for a sound interpretation."

3. The testing techniques provided by the Unversity of Illinois Department of Agronomy must be used in making the tests, and the work must be done by a qualified soil testing technician.

4. The soil test report form should clearly identify the laboratory and should accurately record the results of the soil tests.

5. To maintain an acceptable level of accuracy in the tests, each local laboratory must submit samples to the Agronomy Soil Testing Laboratory for check testing.

6. Recommendations for corrective soil treatment must be made by or under the direct supervision of a qualified person. An agriculture college graduate will be considered qualified if his or her training included work in soils and if he or she has kept abreast of developments in soil technology.

Soil Test Form **A**

INFORMATION SHEET

# DIRECTIONS FOR COLLECTING SOIL SAMPLES

## FIELD SAMPLING

Start for the field to collect soil samples only after you understand the importance of sampling and how to do it. Over a period of years, a farmer is likely to invest several thousand dollars on the basis of results obtained from soil tests in a 40-acre field. It is easily possible to make hundreds of dollars for an extra hour spent in careful sampling and recording the location of each sample. The best laboratory tests in the world made on samples that are carelessly taken are not only worthless but may lead you to spend thousands of dollars for plant nutrients that you don't need while you neglect to buy nutrients that your fields lack.

When the soil finally gets into the test tube in the laboratory, about *1 teaspoonful is going to represent 2 to 5 acres. It had better be the right teaspoonful!*

The leaflet is planned to help you to understand how to get samples that will provide a sound basis for investing your money in fertilizer and limestone. Take time to study it.

## MATERIALS YOU WILL NEED

A supply of at least 11 small paper sacks (for a 40-acre field).
A basket or box for carrying the samples.
A pan or bucket for mixing the small samples.
A trowel, spade, or auger to dig the samples.

### STEP NUMBER 1. PLAN WHERE TO SAMPLE AND HOW MANY SAMPLES TO TAKE.

First check the descriptions under situations A and B to decide which plan to follow.

**Situation A.** Fields that appear to have only one kind of soil and where recent past cropping and fertilizer and limestone treatments have been the same throughout. You may follow a regular pattern as indicated on the diagrams on the back of this sheet.

For a 10-acre field take 4 samples at locations corresponding to 1, 2, 6, and 7 on the diagram for a 20-acre field.

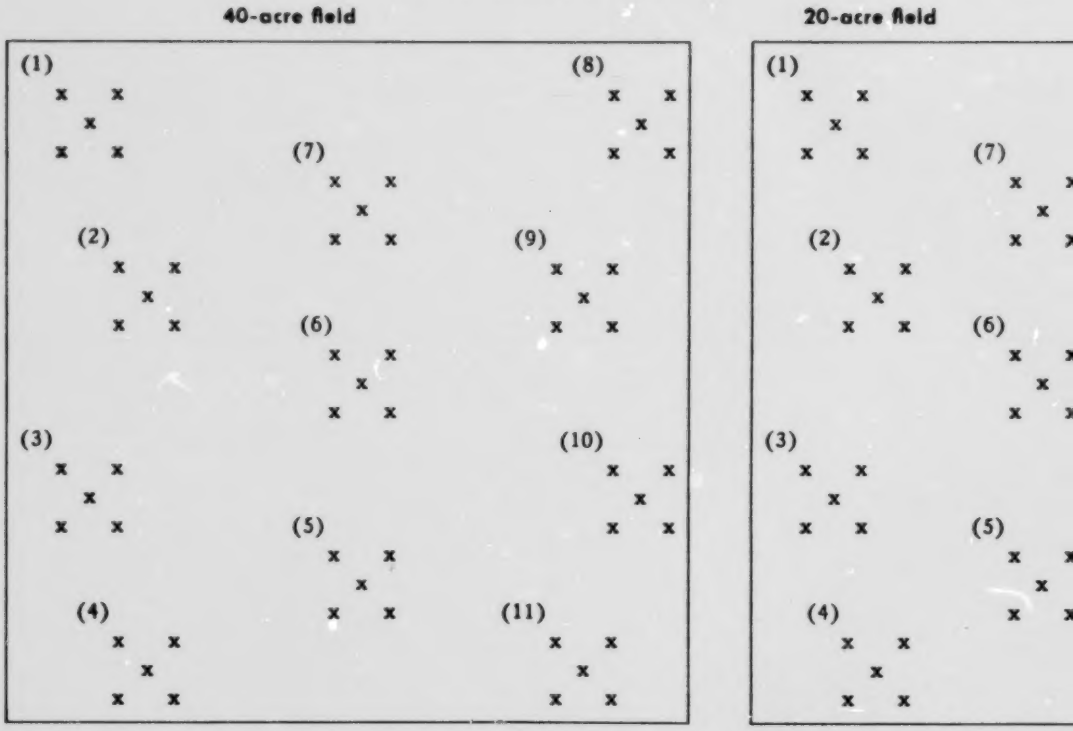
Each sample shown by a number on the diagram is a mixture of 5 small samples taken within a square rod at the places shown by the x marks. The reason for taking these 5 small samples is to make certain that the whole sample does not come from within a band of fertilizer applied in a previous year.

Eleven samples are suggested for a 40-acre field, 7 for 20 acres, and 4 for 10 acres in order to outline areas with different fertility status due to unseen soil differences or differences in previous fertilizer or limestone applications or cropping systems.

**Situation B.** Fields that have different kinds of soil, that have problem areas, or that have been cropped, fertilized, or limed differently in the past 5 to 10 years.

The same general suggestions apply as outlined under situation A, but you will want to take enough additional samples to fully represent the different conditions within the field. This is a matter of judgment, but remember that a few extra samples take little time or money but may give a much better picture of the fertility status of the field. Fields are sampled only once in 4 to 8 years. Don't gamble on short cuts to a good sampling job.

## INFORMATION SHEET




**STEP NUMBER 2. TAKE THE SAMPLES AND RECORD THE LOCATION OF EACH SAMPLE AND OUTLIN SPOTS, KNOLLS, DRAWS, ETC., ON THE MAP.**

This information is needed to help you or the person who interprets the tests arrive at the treatment. If you plan to treat according to soil tests, *th n you must know where each sample came*

**STEP NUMBER 3. PREPARE THE SAMPLES FOR TESTING.**

Let the samples air-dry with the tops of the containers open for several days. Don't rush the process by placing samples on a stove or radiator. This will produce misleading test results.

Break up clods and lumps so the soil will pass through ordinary window screen. The sampl ready for testing.

**STEP NUMBER 4. FILL OUT THE INFORMATION SHEET, SOIL TEST FORM B.**

This form lists the cropping history, previous fertilizer, lime, and manure treatments, and otl formation to supplement the information supplied by the soil tests and thus lead to more sound fe suggestions. *The soil test is an important tool in diagnosing fertility needs and in suggesting treat but it should never be the only tool.* Here is an illustration to prove the point. If you apply lim according to the results of a soil test and then retest within two years, the second test will show siderable limestone requirement even though there is enough in the soil for high yields of legume soil test by itself in this case is misleading.

**STEP NUMBER 5. MAIL OR TAKE THE SAMPLES TO THE LABORATORY.**

Cooperative Extension Work in Agriculture and Home Economics
University of Illinois College of Agriculture and the United States
Department of Agriculture cooperating. Louis B. Howard, Director.
Acts approved by Congress May 8 and June 30, 1914.

Soil Test Form **B**

# SOIL SAMPLE INFORMATION SHEET

**(To accompany soil samples; complete one form for each field)**

DATE _____

_____ County

Township _____ Qtr. _____
Section _____
Field _____
Acres _____
Samples _____

Tests Desired:
pH _____
P-1 _____
K _____
OM _____

TENANT _____ ADDRESS _____

OWNER _____ ADDRESS _____

In order that the results of the test may be properly analyzed and interpreted, the following inform should be submitted with the samples from each field:

1. Soil type name _____.
2. Kind of soil: sandy _____ silt loam _____ clay _____ muck _____.
3. Is drainage good _____ fair _____ poor _____?
4. Has the field been limed recently? _____ When? _____ Amount per acre _____
5. Amount of fertilizer applied per acre last year: N _____ $P_2O_5$ _____ $K_2O$ _____
6. Cropping intentions for next four years, expected yields, and tillage system (plow, chisel, disk, no-till, e

| | Intended crop | Expected yield | Tillage system |
|---|---|---|---|
| This year | | | |
| Next year | | | |
| Third year | | | |
| Fourth year | | | |

7. How deep do you plow? _____
8. Are there any special problems? _____

_____

_____

_____

_____

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## MAP OF THIS FIELD
(Number the sample locations)

Top of map is north

south

Vocational Agriculture Service
434 Mumford Hall
Urbana, Ill. 61801

Soil Test Form **B**

SAMPLE FARM

## SOIL SAMPLE INFORMATION SHEET

**(To accompany soil samples; complete one form for each field)**

DATE September 20, 1980

Brown County

Township Land
Section 12 Qtr. NE
Field I
Acres 66
Samples 22

Tests Desired:
pH X
P-1 X
K X
OM X

TENANT Jack Farming ADDRESS Route 3, Goodland, IL 00101

OWNER Milo Sorghum ADDRESS Fieldcrop, IL 00000

In order that the results of the test may be properly analyzed and interpreted, the following information should be submitted with the samples from each field:

1. Soil type name Drummer, Raub, Parr, Dana.
2. Kind of soil: sandy ____ silt loam X clay ____ muck ____.
3. Is drainage good Parr Dana fair Raub poor Drummer ?
4. Has the field been limed recently? Yes When? 1975 Amount per acre 3.3 Ton/Ac North 46 / 2.0 Ton/Ac South 20
5. Amount of fertilizer applied per acre last year: N None $P_2O$ 100 lbs/Ac East 30 / 200 lbs/Ac West 36 $K_2O$ 150 lbs/Ac East 30 / 200 lbs/Ac West 36
6. Cropping intentions for next four years, expected yields, and tillage system (plow, chisel, disk, no-till, etc.):

| | | Intended crop | Expected yield | Tillage system |
|---|---|---|---|---|
| This year | 1981 | Corn | 200 bu./Ac. | Plow after corn |
| Next year | 1982 | Soybeans | 60 bu./Ac. | No fall tillage after beans |
| Third year | 1983 | Corn | 200 bu./Ac. | |
| Fourth year | 1984 | Soybeans | 60 bu./Ac. | |

7. How deep do you plow? 7"-9".
8. Are there any special problems? The Drummer soil tends to pond in some areas. There is a 10 percent slope in the Northwest section of the field. The area around Site #10 is where the old barnyard was located.

One sample was taken for every 3 acres of land. Each sample is a composite of 5 cores taken 6"-7" deep from an area about 15 feet square. Note Field map to locate sampling sites and the soil types in the field.

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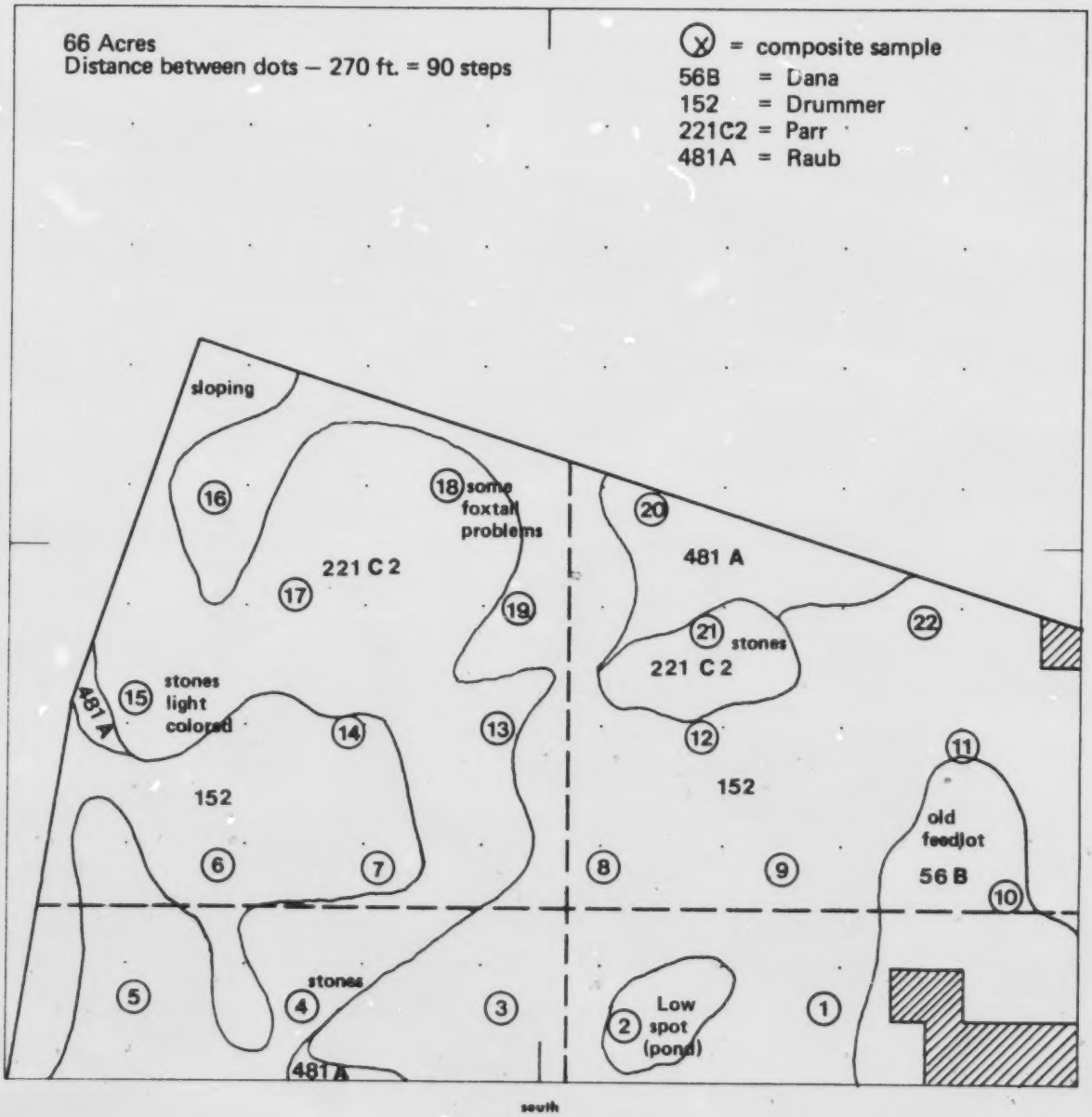
## MAP OF THIS FIELD

**(Number the sample locations)**

Top of map is north




south


Vocational Agriculture Service
434 Mumford Hall
Urbana, Ill. 61801

Information Sheet

SOIL TESTING LABORATORIES - ALPHABETICAL LISTING

January 12, 1979

List of laboratories submitting soil samples for check testing to the Department of Agronomy, University of Illinois at Urbana-Champaign during 1978.

1. Agra Soil Service
   U.S. Hwy. 20
   Stockton, IL 61085
   JoDaviess County

2. Alvey Laboratory
   P.O. Box 261
   209 S. Clinton Street
   Collinsville, IL 62234
   Madison County

3. Belleville Area College
   Dust Kickers Soil Testing
   2500 Carlyle Road
   Belleville, IL 62221
   St. Clair County

4. Brandt's Fertilizer Service Co.
   P.O. Box 276
   Pleasant Plains, IL 62677
   Sangamon County

5. Bruch Laboratory
   Cyndy Bruch
   Box 339, R.R. #1
   Granville, IL 61326
   Putnam County

6. Clark Co. Soil Testing Laboratory
   R.R. #1
   Marshall, IL 62441
   Clark County

7. Crop Chemical Testing
   R.R. #3, Box 147
   Arcola, IL 61910
   Coles County

8. Cumberland Agri. Laboratory
   P.O. Box 95
   Hazel Dell, IL 62430
   Cumberland County

9. Eastern Illinois Soil Testing
   114 S. Chicago, Box 54
   Rossville, IL 60963
   Vermilion County

10. Edwards County Farm Bureau
    Soil Testing Laboratory
    15 S. Fifth Street
    Albion, IL 62806
    Edwards County

11. Edwards Soil Service
    601 N. Court Street
    Pontiac, IL 61764
    Livingston County

12. Effingham Equity
    Soil Testing Laboratory
    P.O. Box 388
    Effingham, IL 62401
    Effingham County

13. Fayette County Farm Bureau
    Soil Testing Laboratory
    112 N. Sixth Street
    Vandalia, IL 62471
    Fayette County

14. Graymont Co-op Association
    Graymont, IL 61743
    Livingston County

15. Greene County Farm Bureau
    Soil Testing Laboratory
    319 W. Side of Square
    Carrollton, IL 62016
    Greene County

16. Grundy County Farm Bureau
    Soil Testing Laboratory
    116 E. Washington
    Morris, IL 60450
    Brundy County

17. Hamilton County Soil Testing
Courthouse
McLeansboro, IL 62859
Hamilton County

18. Hancock Extension Soil Laboratory
P.O. Box 168
Carthage, IL 62321
Hancock County

19. Kaiser Chemical Co.
Soil Testing Laboratory
Sullivan, IL 61951
Moultrie County

20. Key Agricultural Services, Inc.
114 Shady Lane
Macomb, IL 61455
McDonough County

21. LaSalle County Farm Bureau
Soil Testing Laboratory
Rt. 23 North, P.O. Box 88
Ottawa, IL 61350
LaSalle County

22. Macoupin County Farm Bureau
Soil Testing Laboratory
210 N. Broad
Carlinville, IL 62626
Macoupin County

23. Marquise Farm Supply, Inc.
Soil Testing Laboratory
Box 279
Clinton, IL 61727
DeWitt County

24. Meiners Farm Service, Inc.
Soil Testing Laboratory
Colfax, IL 61728
McLean County

25. Mid-American Pipeline Co. (MAPCO)
Soil Testing Laboratory
R.R. #2
Athens, IL 62613
Menard County

26. Midwest Soil Testing Service
Danforth, IL 60930
Iroquois County

27. Mississippi Valley Soil Testing
1610 Keokuk, Box 96
Hamilton, IL 62341
Hancock County

28. Mowers Precision Crop Counseling Service
107 N. Franklin
Toulon, IL 61483
Stark County

29. Irwin H. Parrill
Soil Testing Laboratory
R.R. #2, Box 159
Edwardsville, IL 62035
Madison County

30. Pike County Farm Bureau
Soil Testing Laboratory
Route 36 East
Pittsfield, IL 62363
Pike County

31. Randolph County Farm Bureau
Soil Testing Laboratory
South St. Louis St., Box G
Sparta, IL 62286
Randolph County

32. Richardson Soil Testing Laboratory
R.R. #1
Centralia, IL 62001
Marion County

33. Rich-Law Service Co.
P.O. Box 403
Olney, IL 62450
Richland County

34. Douglas H. Riley
510 S. Euclid Avenue
Princeton, IL 61356
Bureau County

35. Scottland Soil Laboratory
Scottland R. #4
Chrisman, IL 61924
Edgar County

36. Sharp's Soil Testing Service
Tyler Elevator
P.O. Box 337
Elwood, IL 60421
Will County

37. Max Slape
Soil Testing Laboratory
R.R. #1
Shelbyville, IL 62565
Shelby County

38. Shields Soil Service
R.R.
Dewey, IL 61840
Champaign County

39. Skiles Fertilizer Service
Soil Testing Laboratory
P.O. Box 267
Astoria, IL 61501
Fulton County

40. Southern Illinois Farm Foundation
Soil Testing Laboratory
P.O. Box 335
Vincea, IL 62995
Johnson County

41. Sparks Soils Testing Laboratory
122 S. McLean
Lincoln, IL 62656
Logan County

42. Spoon River F.S. Inc.
Soil Testing Laboratory
Ellisville, IL 61431
Fulton County

43. Standard Laboratories
P.O. Box 128
Goodfield, IL 61742
Woodford County

44. Stringer's Soil Service
R.R. #2
Assumption, IL 62510
Christian County

45. Taylor Soil Laboratory
200 Meadow Drive
Macomb, IL 61455
McDonough County

46. Top Soil Testing Service
133 Maple Street
Frankfort, IL 60423
Will County

47. Twin County Service Co.
Soil Testing Laboratory
215 N. 12th Street
Murphysboro, IL 62966
Jackson County

48. Vermilion County Farm Bureau
Soil Testing Laboratory
431 N. Vermilion
Danville, IL 61832
Vermilion County

49. Warren County Farm Bureau
Soil Testing Laboratory
1000 N. Main Street
Monmouth, IL 61462
Warren County

50. White County Farm Bureau
Soil Testing Laboratory
304 E. Robinson
Carmi, IL 62821
White County

51. Whiteside County Farm Bureau
Soil Testing Laboratory
100 East Knox
Morrison, IL 61270
Whiteside County

52. The Zeller Laboratory
2808 W. 4th Street
Dixon, IL 61021
Lee County

## INFORMATION SHEET

## SUGGESTED INSTRUCTIONS FOR OBTAINING

## SOIL SAMPLES FROM LAWNS, GARDENS AND GROUND BEDS

1. Obtain at least one composite sample for each soil difference. Differences can be due to texture, slope, color, drainage or past treatment. If a "problem area" is sampled, keep it separate from the other composite samples.
2. For a composite sample obtain 10-15 samples from each area. Samples from individual beds should not be mixed. Take samples to a depth of 6 inches in flowerbeds and gardens and 4 inches in lawns.
3. Mix the soil for the composite sample and take out about one pint. Label each composite sample with a number and name. Keep a record of the area from which the samples came and fill out the information sheet "B" as completely as possible. Also include the following:
   a. The size of area (dimensions or number of square feet): _____
   b. How many years has garden (or lawn or flowers) been in this spot? _____
   c. Do you have manures, compost, leaves or other organic material available each year? (Yes or No) _____ If so, how much? _____
   d. What particular difficulties do you have with plant growth in this area?
      _____

## INFORMATION SHEET

## SUGGESTED PROCEDURES FOR SAMPLING GREENHOUSE SOILS

A. **Stockpiles of Soil Mixes**

1. Take 10–15 samples from various locations in the stockpile and mix to obtain one composite sample.
2. Do not sample the surface. (Salt content may be higher due to evaporation.)
3. Sample to a depth of 10–12 inches.

B. **Potted Crops**

1. Use 10–15 pots to make a cross-section of a composite sample.
2. In large pots a probe can be used with minimum damage to the root system. In small pots the root ball will need to be removed from the pots and a sample of soil removed from the top of the bottom to the root ball where the roots are actively growing. The soil can be replaced by soil stock mix.

## WORKSHEET 1

## SOIL SAMPLING

1. List four reasons for taking soil samples:

   a. _____

   b. _____

   c. _____

   d. _____

2. What does a soil test show?

   a. _____

   b. _____

   c. _____

3. What other techniques are used to evaluate fertilizer responses?

   a. _____ e. _____

   b. _____ f. _____

   c. _____ g. _____

   d. _____

4. What factors influence the number of samples taken from an area or field?

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

5. Describe some pitfalls to avoid in obtaining a good soil sample.

   a. _____ e. _____

   b. _____ f. _____

   c. _____ g. _____

   d. _____

6. Describe the procedure to follow when collecting a soil sample.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

7. Why is information about past history included with the sample?

a. _____

_____

b. _____

_____

8. When and how often should a soil sample be taken?

a. _____

_____

b. _____

_____

c. _____

_____

9. What soil testing services are locally available?

a. _____

b. _____

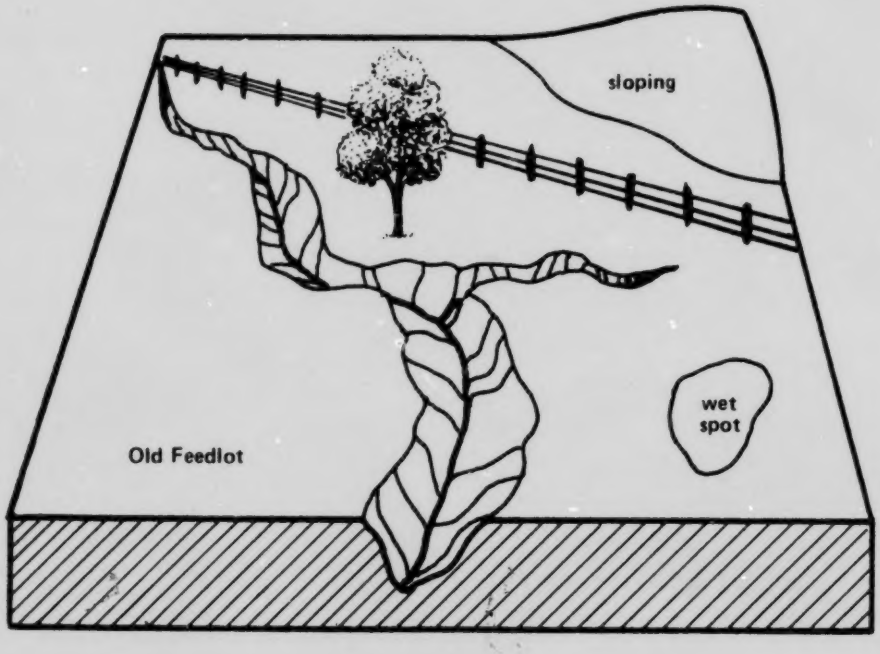
c. _____

10. What equipment is needed to take a soil sample?

a. _____ c. _____

b. _____ d. _____

11. Place a small number where each composite sample would be taken in the 20 acre plot below.




12. Sketch a diagram of how you would obtain one composite sample.

## JOB SHEET 1

## SECURING A SOIL SAMPLE

Locate a field, lawn, or garden and complete the following steps:

1. Divide the field, lawn, or garden into sampling acres.
2. Obtain the necessary samples from the sampling area.
3. Complete Form "B." The field map should include the acres, soil types within the sampled area, and the location of each sample. (Soil types can be determined by using the county platbook and soil survey book.)
4. Deliver soil samples along with Form B to a soil testing laboratory.

TEACHER'S KEY
WORKSHEET 1

SOIL SAMPLING

1. List four reasons for taking soil samples:

   a. Makes more efficient use of resources.

   b. Maintain high fertility level.

   c. Avoid applying wrong elements.

   d. Rate is matched to crop yields.

2. What does a soil test show?

   a. pH level

   b. phosphorus level

   c. potassium level

3. What other techniques are used to evaluate fertilizer responses?

   a. Plant and tissue tests

   b. Observed deficiency symptoms

   c. Research data

   d. Demonstration plots

   e. Fertilization guides

   f. Knowledge of nutrient removal by cro

   g. Past crop responses to fertilizer

4. What factors influence the number of samples taken from an area or field?

   a. Slope, color, texture, structure of soils

   b. Erosion

   c. Past treatments

   d. Cropping system

   e. Land use history

5. Describe some pitfalls to avoid in obtaining a good soil sample.

   a. Don't mix different soil types

   b. Don't use dirty or oily tools

   c. Don't artifically dry samples

   d. Don't take sample from fertilizer band

   e. Don't take samples from fence rows, dead furrows, etc.

   f. Don't sample below plow depth

   g. Don't lose the map of sampling areas

6. Describe the procedure to follow when collecting a soil sample.

   a. Use soil auger, soil tube, spade or trowel

   b. Remove surface trash

   c. Use center ½" of spade slice

   d. Use recommended number of sampling areas

   e. Sample to plow depth

   f. Use clean containers

   g. Mix thoroughly and place in marked bags.

7. Why is information about past history included with the sample?

   a. Provides information about practices used which might influence fertility responses.

   b. Former yield information and future goals are needed to provide an appropriate fertility recommendation.

8. When and how often should a soil sample be taken?

   a. 4 – 6 years

   b. Before tillage or soil treatments

   c. In fall for spring planted crops and in summer for fall planted crops.

9. What soil testing services are locally available?

   a. Illinois Soil Testing Laboratories

   b. Farm Service Dealers

   c. Other: schools and private institutions

10. What equipment is needed to take a soil sample?

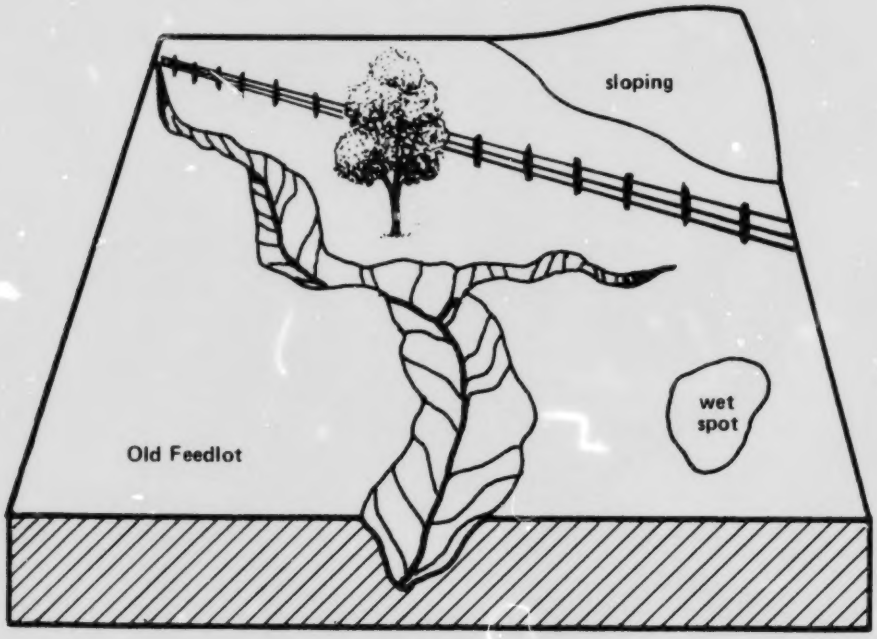
    a. Small sacks

    b. Pan or bucket

    c. Probe, auger, or spade or trowel

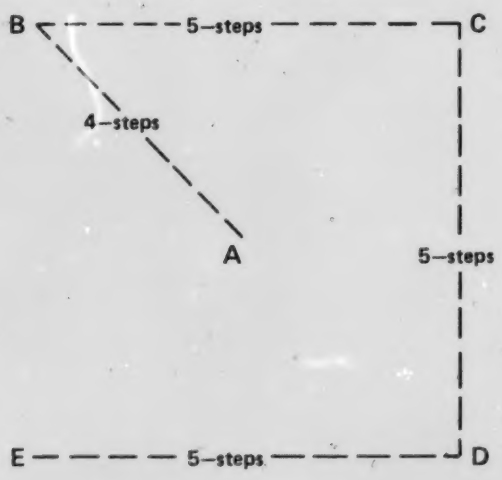
    d. Box for carrying samples

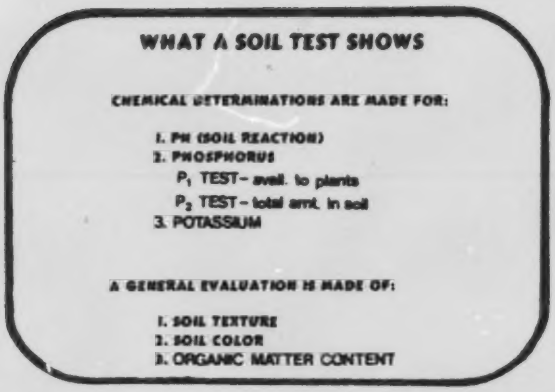
11. Place a small number where each composite sample would be taken in the 10 acre plot below. There are many combinations, but avoid the tree, eroded area, and fence row. Sample separately old feedlot, wet spot, and sloping area.




Take 7 samples for the 20 acres.

12. Sketch a diagram of how you would obtain one composite sample.

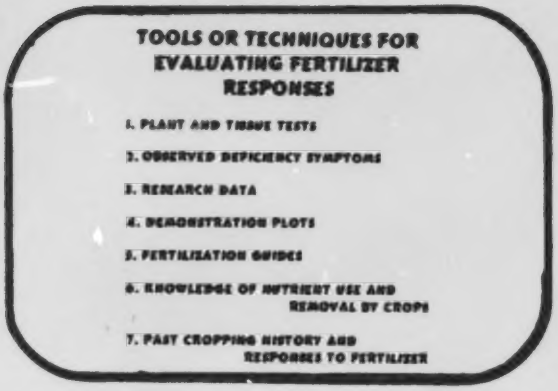



WHAT A SOIL TEST SHOWS
CHEMICAL DETERMINATIONS ARE MADE FOR:
1. PH (SOIL REACTION)
2. PHOSPHORUS
$P_1$ TEST - avail. to plants
$P_2$ TEST - total amt. in soil
3. POTASSIUM
A GENERAL EVALUATION IS MADE OF:
1. SOIL TEXTURE
2. SOIL COLOR
3. ORGANIC MATTER CONTENT

1. A soil test is a chemical test to determine the amounts of various plant nutrients present in the soil in forms that are available to plants. Soil testing can be done in a laboratory, or with soil test kits in the field. Each type of soil test has its advantages and disadvantages.

   a. The soil test kits, commonly called "quick, rapid, or indicator" tests, are faster; and the testing can be done in the field in a few minutes. These tests; however, are not as accurate as a laboratory soil test.

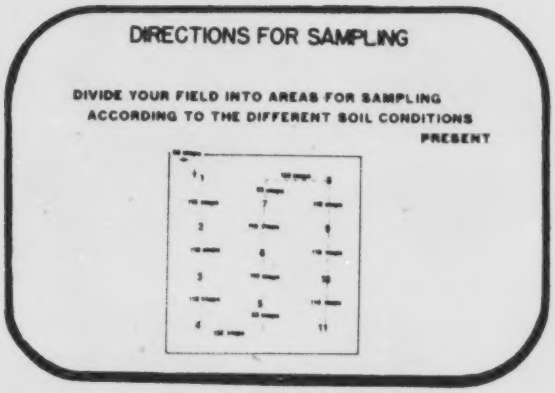
   b. The laboratory soil test takes more time because it is more precise. Representative good samples are essential to reliable soil tests.


TOOLS OR TECHNIQUES FOR EVALUATING FERTILIZER RESPONSES
1. PLANT AND TISSUE TESTS
2. OBSERVED DEFICIENCY SYMPTOMS
3. RESEARCH DATA
4. DEMONSTRATION PLOTS
5. FERTILIZATION GUIDES
6. KNOWLEDGE OF NUTRIENT USE AND REMOVAL BY CROPS
7. PAST CROPPING HISTORY AND RESPONSES TO FERTILIZER

2. In addition to the experience of a farmer, there are a number of other tools or techniques available for determining nutrient requirements. These are listed on the transparency and the advantages and disadvantages of each can be discussed.

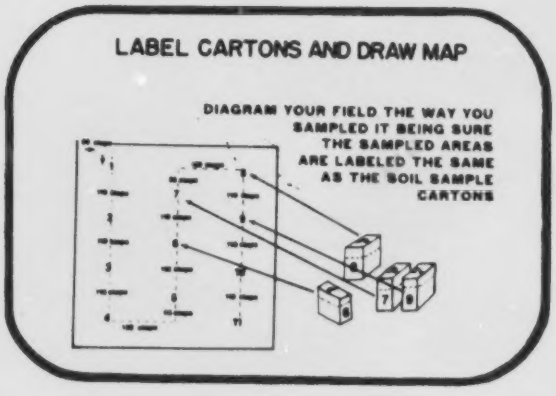
INFORMATION FOR COLLECTING SOIL SAMPLES
GET SAMPLE CARTONS AND INFORMATION SHEETS FROM YOUR AGRICULTURAL OCCUPATIONS TEACHER, OR EXTENSION ADVISER. MAKE SOIL TEST EARLY - WEEKS BEFORE PLANTING

3. An important item that must accompany the soil sample is the information sheet. This sheet, properly completed, aids in the interpretation of the soil test and in making fertilizer recommendations. The sheet should be completed and sent with the soil samples. The time spent giving specific answers is well spent.

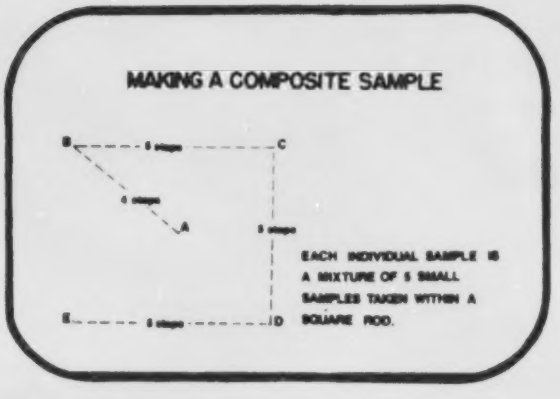

DIRECTIONS FOR SAMPLING
DIVIDE YOUR FIELD INTO AREAS FOR SAMPLING ACCORDING TO THE DIFFERENT SOIL CONDITIONS PRESENT

4. For fields that appear to have only one kind of soil or that have been cropped, fertilized, or limed the same, you may collect samples as shown by the diagram on the transparency. If there are soil difference or problem areas, you may want to also sample these areas. A few extra samples take little time or money but may give a much better picture of the fertility status of the fields. Fields are sampled only once in 4 to 8 years.

5. Over a period of years, a farmer is likely to invest several thousand dollars on the basis of results obtained from soil tests in a 40-acre field. It is easily possible to make hundreds of dollars for an extra hour spent in careful sampling and recording the location of each sample. Avoid areas that are not representative or that will give inaccurate results. The best laboratory test in the world made on samples that are carelessly taken are not only worthless but may lead you to spend thousands of dollars for plant nutrients that you do not need while you neglect to buy nutrients that your fields lack.


LABEL CARTONS AND DRAW MAP
DIAGRAM YOUR FIELD THE WAY YOU SAMPLED IT BEING SURE THE SAMPLED AREAS ARE LABELED THE SAME AS THE SOIL SAMPLE CARTONS

6. Take the samples and record the location of each and outline low spots, knolls, draws, etc., on the map. This information is needed to help you or the person who interprets the test to arrive at the proper treatment. If you plan to treat according to soil tests, then you must know where each sample came from.

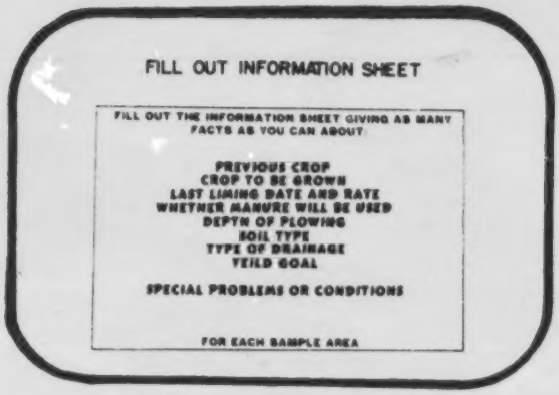



7. The reason for taking these five small samples is to make certain that the whole sample does not come from within a band of fertilizer applied in a previous year.

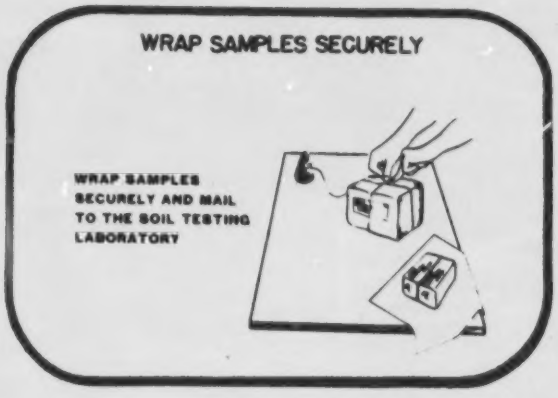
Eleven samples are suggested for a 40-acre field, seven for 20 acres, and four for 10 acres. This number is needed in order to outline areas with different fertility status or to unseen soil differences in previous fertilizer or limestone applications or cropping systems.

SAVE A HANDFUL OF SAMPLE
PLACE A HANDFUL OF SOIL INTO A CARTON AND LABEL WITH ITS SAMPLE NUMBER AND OTHER INFORMATION CALLED FOR

12. Be sure to label sample and save a handful of soil.


FILL OUT INFORMATION SHEET
FILL OUT THE INFORMATION SHEET GIVING AS MANY FACTS AS YOU CAN ABOUT
PREVIOUS CROP
CROP TO BE GROWN
LAST LIMING DATE AND RATE
WHETHER MANURE WILL BE USED
DEPTH OF PLOWING
SOIL TYPE
TYPE OF DRAINAGE
YEILD GOAL
SPECIAL PROBLEMS OR CONDITIONS
FOR EACH SAMPLE AREA

13. Fill out Soil Test Form B. This form lists the cropping history, previous fertilizer, lime, and manure treatments, and other information to supplement the information supplied by the soil tests and thus lead to more sound fertility suggestions. The soil test is an important tool in diagnosing fertility needs and in suggesting treatments, but it should never be the only tool. Here is an illustration to prove the point. If you apply limestone according to the results of a soil test and then retest within two years, the second test will show a considerable limestone requirement even though there is enough in the soil for high yields of legumes. The soil test by itself in this case is misleading.




14. Mail or take samples to the laboratory. The samples will be air-dried for several days at the laboratory before tested. Do not place samples on a stove or radiator for quick drying. This will produce misleading test results.

TEACHER'S KEY
SAMPLE TEST QUESTIONS

## COLLECTING SOIL SAMPLES

1. Explain in writing two reason for testing soil.

   a. More efficient use of resources.

   b. Maintain high fertility.

   c. Avoid applying wrong elements.

   d. Rate is matched to crop yields.

2. Select from the list below, three major items for which soils are tested. Circle the correct answer.

   a. Nitrogen
   b. Calcium
   (c.) pH
   d. Zinc
   e. Manganese
   (f.) Phosphorus
   g. Iron
   (h.) Potassium

3. Name four techniques, other than soil sampling, which are used to evaluate fertilizer responses.

   a. Plant and tissue tests — Fertilization guides

   b. Observed deficiency symptoms — Knowledge of nutrient removal

   c. Research data — Past responses to fertilizer

   d. Demonstration Plots

4. Place an "X" in the blank to select the correct procedure to follow for collecting a representative soil sample.

   _____ a. Ten samples should be taken in each field or area.

   _____ b. Samples should be taken from soil below eight inches in cropland and pasture land.

   _____ c. Approximately one quart of mixed soil should be placed in a suitable container for sending to a soil testing laboratory.

   X d. Take the samples and record to the location of each and outline low spots, knolls, draws, etc. on the map.

5. Select from the list below, the two areas from which soil samples should not be taken. Circle the sites.

   a. bottomland
   (b.) fence rows
   c. pasture land
   d. upland
   e. wet spots
   f. acid soils
   (g.) roads and lanes

6. Name two items of information that should be submitted on the information sheet with the soil samples.

| | | | |
|---|---|---|---|
| a. | Previous crop | Last liming date and rate | |
| | Crop to be grown | Soil type | If manure is used |
| b. | Special problems | Yield goal | Depth of plowing |

7. Why is it not necessary to analyze soil every year?

   It takes a period of years for the soil fertility levels to adjust. There is not any notable yearly changes.

8. Why is proper identification of the soil samples important?

   Different fertilizer rates may be recommended for different samples.

9. Identify four sampling tools.

a. Soil auger

b. Trowel

c. Shovel or spade

d. Soil probe

10. Name two locations in Illinois where soil samples can be sent for testing.

    a. Illinois Soil Testing Labs.

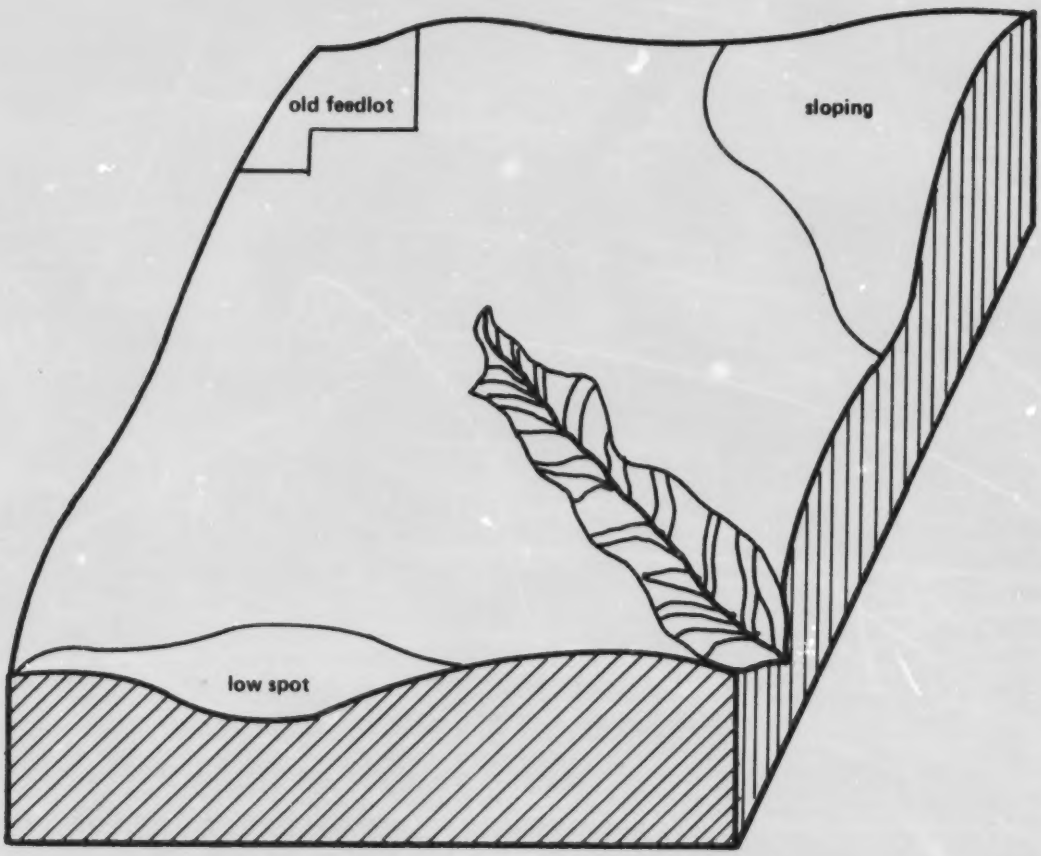
    b. Farm Service Dealers

11, On the drawing below, complete the following tasks:

    a. Divide a field into sampling areas. The total field size is 80 acres.

    b. Place a small number on each sampling site in one of the divided areas.

    Area should be divided into 2—40 acre fields.
    Avoid eroded area.
    Sample old feedlot, low spot, and sloping area separately.
    Use 11 sampling areas/40 acres.



## UNIT F: SOIL SCIENCE AND CONSERVATION OF NATURAL RESOURCES

### PROBLEM AREA: APPLYING SOIL SAMPLE TEST RESULTS

SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with ninth grade or beginning students enrolled in an agricultural occupations program. The recommended time for teaching this problem area is during the fall or early winter. The estimated time for teaching this problem area is 3 to 5 days depending on how much time the teacher wishes to spend on discussion and conducting the suggested exercises. The materials in this problem area were selected and written with the following assumptions:

1. That agriculture students should be able to interpret and explain soil sample tests results.
2. That agriculture students should be able to recommend fertilizer rates by using soil sample test results.

The instructor is encouraged to conduct a local search to locate other supplementary materials. The items in this problem area are for reference or modification as the teacher adapts these materials to his/her local situation.

CREDIT SOURCES:

These materials were developed through a funding agreement, R-33-21-D-0542-388 with the Illinois State Board of Education, Department of Adult, Vocational and Technical Education, Research and Development Section, 100 North First Street, Springfield, Illinois 62777. Opinions expressed in these materials do not reflect, nor should they be construed as policy or opinion of the State Board of Education or its staff.

The teacher's guide, worksheets, and sample test questions were developed by Jerry Pepple, Department of Vocational and Technical Education, University of Illinois. The transparency masters and transparency discussion guides and soil test report forms were prepared by Vocational Agriculture Service, University of Illinois. The information sheets "Optimum pH Range for Vegetable Crops" and "Soil Test Interpretation," were developed by Horticulture Department, Vegetable Crop Division, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Rural Core Curriculum Pilot Test Teachers.

## TEACHER'S GUIDE

I. Unit: Soil science and conservation of natural resources.

II. Problem area: Applying soil sample test results

III. Objectives: At the close of this problem area the students will:

1. Be able to determine the fertility needs of various soils based on soil sample analysis results.
2. Understand the importance of soil pH.
3. Understand the primary functions and limitations of soil tests.

IV. Suggested interest approaches:

1. Have students interpret results from the soil tests results of their own farms or S.O.E. projects.
2. Have a fertilizer dealer discuss and help interpret the soil test results.
3. Lead a discussion on the problems of using too much or too little fertilizer in a field.

V. Anticipated problems and concerns of students:

1. How much fertilizer do I need to put on my field? Lawn? Houseplants? Vegetables?
2. What does N, P, and K mean?
3. What does pH refer to in a soil?
4. How does pH affect crop yields?
5. How do I determine the amount of fertilizer to use from these results?
6. How often do I need to take soil tests?
7. What are some limitations of soil tests?

VI. Suggested learning activities and experiences:

1. Have class read Soil Test Forms D–2, D–3, D–4, and Soil Treatments Based on Soil Tests. Record tentative answers to the problems and concerns identified by the class and instructor.
2. Present and discuss transparencies 1 through 9 as students complete Worksheet 1 (soil pH).
3. Hand out Worksheet 2 (soil phosphorus and potassium). Show transparencies 10 through 20.

4. Have students develop maps of their field showing pH, $P_1$, and K recording the information as shown on the Sample Farm Example.

5. Have each student make an oral or written report explaining the results of their soil tests.

6. Show a film on soil fertility, such as:

   a. "Making the Most of a Miracle"
   b. "Nutrient Deficiency Symptoms in Plants"
   c. "Our Living Soil"

7. Have the students perform their own soil tests using a soil test kit and a pH meter. Use VAS 4002a, 4003b, 4004b for procedures.

VII. Application procedures:

1. At the close of this problem area the student will be able to explain the fertility recommendation on a soil test and determine an appropriate fertility program on his/her S.O.E.P. or other assigned project.

VIII. Evaluation:

1. Prepare and administer a pencil and paper test using the Sample Test Questions as possible test items.

2. Collect and grade Soil Worksheets 1 and 2.

3. Give credit for oral or written reports.

4. Give credit for completing own soil tests.

IX. References and aids:

1. Soil Treatments Based on Soil Tests.

2. VAS Unit 4002a, pH Test for Soil Acidity, Vocational Agriculture Service, University of Illinois.

3. VAS Unit 4003b, Testing Soil for Phosphorus, Vocational Agriculture Service, University of Illinois.

4. VAS Unit 4004b, Determining Available Potassium in Soils, Vocational Agriculture Service, University of Illinois.

5. Soil Testing and Fertility Transparencies and Study Guide, Vocational Agriculture Service, University of Illinois.

6. Worksheets 1 and 2.

7. Soil Test Kit and pH Meter.

8. Complete soil test results forms B, D–1, D–2, D–3, and D–4, Vocational Agriculture Service, University of Illinois.

9. Handouts "Optimum pH Range for Vegetable Crops," and "Soil Test Interpretations."

10. Films are available through free films catalogs located in your instructional resource center.

    a. Modern Talking Picture Service, 2323 New Hyde Park Road, New Hyde Park, New York 11040.

    b. The Farm Film Foundation, 1425 H. Street N.W., Washington, D.C. 20005.

Soil Test Form D-1

# SOIL TEST REPORT

_____ County

Samples brought in by _____

Date: _____ (received) _____ (tested)

Samples tested by _____

Tenant: _____ Address: _____

Owner: _____ Address: _____

This report gives you the results of the laboratory tests on your samples.

I suggest that you *keep this report in a permanent folder. Record right on the field maps* the amounts of lime a tilizer that you apply and the dates when you apply them. This record will help you to interpret the next test on th and will also give you a long-term inventory that will show whether soil fertility is being built up, is being maintaine declining.

| Field and sample number | Acres | pH Test for acidity | $P_1$ Test for available phosphorus | K Test for potassium | Organic matter or soil color | Comme |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

## SOIL TESTS ARE ONLY PART OF THE PICTURE

Soil tests are an inventory of the nutrients and acidity in your soil. You have to decide the kind a and when to apply fertilizer and lime. Neither your local dealer nor your extension adviser can gi answer because only you know the amount of money that you have to invest and the alternative uses you have.

There are several interrelated parts to your crop and soil management programs besides the soil t are a few.

**Cropping system.** The fertility needs for various cropping systems are different. For example that includes alfalfa and clover has a high requirement for lime, phosphorus, and potassium, but les nitrogen. Corn and soybeans have relatively lower requirements for lime and phosphorus, but corn high level of nitrogen and both crops require a high level of potassium. Because corn returns most of sium to the soil in the stalks, the maintenance need for potassium with continuous corn is less than cropping systems.

**Livestock and manure.** If you feed livestock and conserve the manure, you can return about nitrogen, 4/5 of the phosphorus, and 9/10 of the potassium that is fed. In planning your fertilizer pro may credit manure with the following nutrients per ton of stable manure if handled carefully to nutrient losses: 10 pounds of nitrogen, 40 to 50 percent available in the first year, 2 pounds of p (5 pounds of $P_2O_5$), about 40 percent available in the first year, and 8 pounds of potassium (10 pound all available in the first year. If the manure has been exposed to considerable leaching, the nitrogen sium levels will be much lower.

**Production potential of your soil.** Through careful study of soil-experiment field data and far the University of Illinois has developed estimates of the yield potentials for many Illinois soils. Y this information from your extension adviser or other sources in your county.

**Good management practices.** You will get most profitable returns from fertilizer only if you plo plant on time, control weeds, diseases, and insects, and choose the best crop varieties. As you set h goals and apply more fertilizer, it becomes increasingly important to do a good job of farming in every

**What if the soil test is variable?** You may have a large variation among tests on a field and wonde reason is and, more important, what to do about it. First look at the pattern of the tests over the fiel is a definite pattern of high tests in one part and low tests in another, check to see whether there is a in soil type. Second, try to recall whether the field was farmed as separate fields at some time i Third, check your soil-test records for this field from previous tests or, if you have no records, try to whether the different areas were limed or fertilized differently at some time during the past 5 to Whether or not you find the explanation for large differences in tests, you can split the field and a treatments of lime and fertilizer according to indicated deficiencies.

**If there is no consistent pattern of high and low tests,** then you will have to choose between lowest tests or an average of the tests as a guide to the amount to apply. If you find no explanatio differences in tests, you should consider taking a new set of samples from the field.

**What to do about nitrogen?** No test has been found to reliably indicate the amount of nitrogen t soils will supply for a growing crop. You will want to check with your county extension adviser or lizer dealer for the latest suggestions on nitrogen rates.

**Vocational Agriculture Service**
**434 Mumford Hall**
**Urbana, Ill. 61801**



I-F-2-8

Soil Test Form **D-2**

# LIME — MAP AND INTERPRETATION

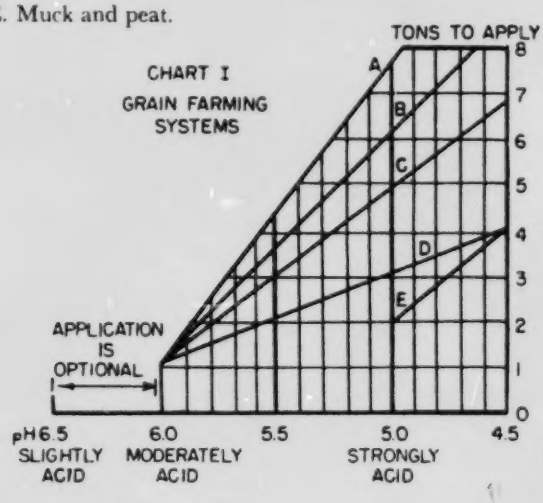
The field map below shows the pH for each sample. Figures on the charts for limestone needed are based
umptions:

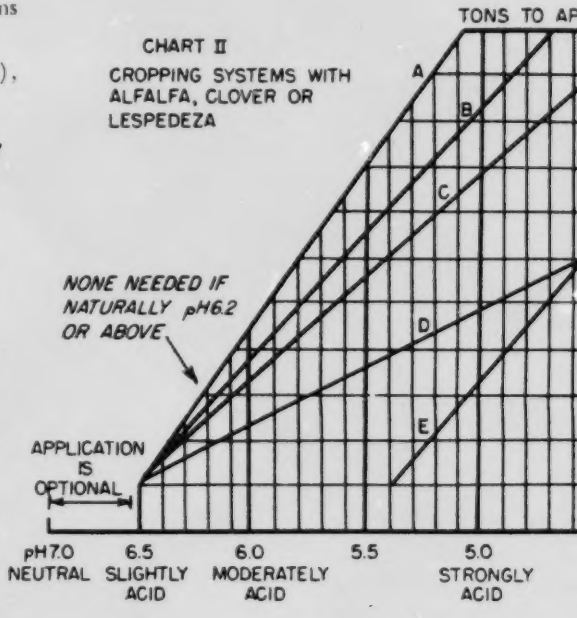
1. A 9-inch depth of plowing. For each inch less, the limestone requirement may be reduced by 10 percent.
2. Typical-fineness limestone — 90 percent through 8-mesh, 60 percent through 30-mesh, 30 percent through
3. A calcium carbonate equivalent (total neutralizing power) of 90 percent. (See back of sheet for explana

If these assumptions do not apply to your situation, adjust the limestone rate accordingly.

## STEPS TO FOLLOW

1. Use Chart I for grain systems and Chart II for alfalfa, clover, or lespedeza.
2. Decide which soil class fits your soil —
   - A. Silty clays and silty clay loams (dark).
   - B. Silty clays and silty clay loams (light and medium). Silt and clay loams (dark).
   - C. Silt and clay loams (light and medium), sandy loams (dark), loams (dark and medium).
   - D. Loams (light), sandy loams (light and medium), sands.
   - E. Muck and peat.
3. Find your soil's pH along the bottom of the cha
4. Follow up the vertical line until it intersects th line A, B, C, D, or E that fits your soil.
5. Read the suggested rate of application along side of the chart that you are using.




## SOIL-ACIDITY MAP

## REMARKS

If the amount of limestone is 6 to
more and initial cost is a factor, apply
first time and the rest 2 to 4 years



For more information on liming, see the back of this sheet and also Circular 721 (mimeographed).

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# INFORMATION TO HELP YOU PLAN A LIMING PROGRAM

## Reasons for Liming

Liming acid soils improves most crops because:

1. It reduces the solubility of manganese and aluminum that are present in strongly acid soils in amounts lar to be toxic, especially to alfalfa and clover.

2. It improves the soil for microorganisms that speed the decay of plant residues, thus releasing more nit phosphorus for crop plants.

3. It favors the growth of nodule-forming bacteria (those that take nitrogen from the air) on alfalfa, clover beans.

4. The best balance in availability of minor elements is found in soils that are neutral or only slightly acid.

5. Phosphorus is more available in soils that are near neutral in acidity than it is in strongly acid soils.

## Suggested pH Goals

For cropping systems with **alfalfa** and **clover**, maintain a pH of 6.5 or above. But if the soils have a pH of 6. without ever having been limed, neutral soil is just below plowing depth and it will probably not be necessary to a stone.

For **cash-grain** systems (no alfalfa or clover), maintain a pH of at least 6.0. If the soil test shows that the apply limestone to prevent a drop below 6.0. Farmers may choose to raise the pH to still higher levels. After the vestment, it costs little more to maintain a pH of 6.5 than one of 6.0. The profit over a 10-year period will be aff little since the increased yield will about offset the original cost of the extra limestone (2 or 3 tons per acre) pl Raising the pH above 6.5 in cash-grain systems unnecessarily increases the risk of nitrogen loss through denitrifi

The amounts of **soil organic matter** that correspond to the color terms used in describing soil classes (exclud on the other side of the sheet are: light — less than 2½ percent; medium — 2½ to 4½ percent; dark — more than 4

## Liming Materials

Nearly all of the liming material used in Illinois is agricultural ground limestone, commonly called agstone o may be calcitic (nearly all calcium carbonate) or dolomitic (containing magnesium). The maximum magnesium content is about 45 percent. There is no area in Illinois where one type is preferred over the other.

The two main characteristics that determine the value of lime are its neutralizing power and its fineness.

The **neutralizing power** (calcium carbonate equivalent) of limestone is its power to neutralize soil acids as with the neutralizing power of pure calcium carbonate. The neutralizing power of limestone sold in Illinois ranges f 65 to 109. The higher the neutralizing power, the more valuable the limestone. Limestone that is in the lower be just as good a bargain as that in the higher range *if it is priced in line with the difference in neutralizing pow*

The **fineness**, or size, of limestone particles largely determines the rate at which they react with soil acids. The practical problem is how to compare limestones that differ in fineness and price. Your extension adviser and ASC office have the screen scores showing the fineness of limestone for sale in your area.

If you are liming a strongly acid soil shortly before seeding alfalfa or clover, the values for 1 year in the table at right are the best guide. If lime is applied on sod before plowing for corn, the 4-year values are the best to use. If the fields have been limed in the past and a long-term maintenance application is to be made, the 8-year figures are satisfactory.

**Comparative Values of Limestone of Varying Sizes Evaluated 1, 4, and 8 Years After Ap**

| Size fraction | Years after appl | |
|---|---|---|
| | 1 | 4 |
| Through 60 mesh..... | 100 | 100 |
| 30 to 60 mesh..... | 50 | 100 |
| 8 to 30 mesh..... | 20 | 45 |
| Over 8 mesh..... | 5 | 15 |

## When to Lime

Fortunately limestone may be applied at many points in the crop rotation. It is best to lime soils for the fi months to a year ahead of the alfalfa or clover seeding, but in emergencies limestone that contains a high proport mesh material can be disked in (not plowed under) just ahead of seeding.

## Retesting Limed Fields

Soil tests within 2 years after liming are unreliable. Where lime has been applied according to soil tests, alfa and other crops will grow well even though the soil still tests more acid than is desired. There is little reason to re limed field more often than about every 4 years. Eight to 10 years is often enough to retest fields with a naturally

Where high rates of nitrogen (150 pounds or more per year) are applied, retesting is suggested every 4 yea nitrogen fertilizer increases soil acidity.

Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agricult CLAAR, *Director*, Cooperative Extension Service, University of Illinois at Urbana-Champaign.

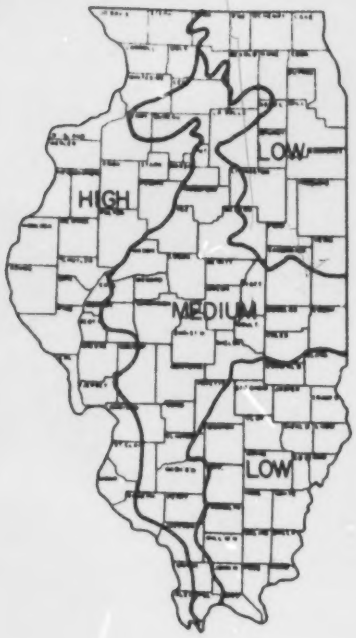
Vocational Agriculture Service
434 Mumford Hall
Urbana, Ill. 61801

I-F-2-10

Soil Test Form D-3

# PHOSPHORUS — MAPS AND INTERPRETATION

## PHOSPHORUS-SUPPLYING POWER




## FIELD MAP OF $P_1$ TEST

The soil test will probably increase about 1 pound for every 9 pounds of $P_2O_5$ fertilizer (4 pounds P) applied. Rates of 120 and 150 pounds are for those who desire a rapid buildup in available phosphorus.

The highest drill rates are considered to be all that can be profitably placed in the band but they will have little effect on the soil test in following years and hence do not substitute for larger amounts broadcast for rapid buildup.

## STEPS TO FOLLOW

**1.** Illinois has tentatively been divided into four regions in terms of inherent phosphorus-supplying power of the soil below plow layer in dominant soil types. These regions are shown on the map of Illinois at left. *Decide into which group your soil falls* with respect to phosphorus-supplying power.

**2.** Consulting the table at right and the present phosphorus levels on your field as shown on the field map on this sheet, *study the paragraph checked below.*

Suggested Long-Term Goals for $P_1$ Test Levels

| Phosphorus-supplying power | Where row fertilizer is applied for corn | Where no row fertilizer is applied for corn |
|---|---|---|
| Low | 40–50 | 50–60 |
| Medium | 35–45 | 40–50 |
| High | 30–40 | 35–45 |

☐ Phosphorus is below the most profitable level. Phosphorus applications should, therefore, be large enough to not only meet the needs of the next crop but also to raise the soil test level.

☐ Phosphorus is at the suggested level. You may broadcast phosphorus this year and, thereafter, 50 pounds of $P_2O_5$ annually (or 100 pounds to last 2 years or 150 pounds to last 3 years) to at least maintain the test level until the field is sampled again.

☐ Phosphorus is well above the level believed to be needed. Therefore no yield increase is likely from an application of phosphorus this year.

☐ Phosphorus is so high that you run the risk of creating problems with other nutrients.

**3.** *Choose between rock phosphate and more available phosphates.* (See back of sheet.)

**4.** Consulting the table below, *decide where and how to apply the needed phosphorus for maintenance applications on alfalfa and clover.*

| $P_1$ test: Soil region (see map) | | | Percent possible yield | Pounds of $P_2O_5$ to be added per acre based on the $P_1$ test: Broadcast | Through planter or drill |
|---|---|---|---|---|---|
| *low* | *med.* | *high* | | for corn or soybeans | |
| 20 | 10 | 7 | 69 | (or (a) 90 to 150 | plus 20 to 40 |
| 25 | 15 | 10 | 83 | (or (b) | 40 to 60 |
| 30 | 20 | 15 | 90 | 60 to 120 | or 30 to 40 |
| 38 | 30 | 20 | 97 | 60 | or 20 to 30 |
| 45 | 40 | 30 | 98+ | Phosphorus may be applied to maintain the soil test. Little or no response likely in the year of application. | |
| | *all regions* | | | for wheat and oats | |
| | 10 to 15 | | Below 47 | 90 to 150 | plus 30 |
| | | | | | or 90 |
| | 20 | | 57 | 60 to 120 | plus 30 |
| | | | | | or 80 |
| | 30 | | 72 | 60 to 90 | or 60 |
| | 40 | | 82 | 60 | or 30 to 60 |
| | 60 | | 92 | | 30 |

| | | | for alfalfa and alfalfa-grass mixtures before seeding when seeded alone | | | |
|---|---|---|---|---|---|---|
| | | | *broadcast seeding* | | *band seeding* | |
| *low* | *med.* | *high* | *expected yield per acre (tons)* 2-3 | 3-5 | *expected yield per acre (tons)* 2-3 | 3-5 |
| 25 | 15 | 10 | 120 | 180 | 60 | 90 |
| 30 | 20 | 15 | 90 | 150 | 50 | 80 |
| 38 | 30 | 20 | 60 | 90 | 30 | 60 |
| 45 | 40 | 30 | 60 | 60 | 30 | 40 |
| 60 | 50 | 40 | .. | .. | 30 | 30 |

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## INFORMATION TO HELP YOU PLAN A PHOSPHORUS PROGRAM

### What Determines the Phosphorus-Supplying Power?

**High phosphorus-supplying power** means:

1. The amount of available phosphorus ($P_1$ test) in the subsoil is relatively high.
2. The conditions are favorable for good root penetration and branching in the subsoil.

**Low phosphorus-supplying power** may be caused by one or more of the following factors:

1. A low supply of available phosphorus in the subsoil because (a) the parent material was low in phosphorus; (b) phosphorus was lost in the soil-forming process; or (c) the phosphorus is made unavailable by high pH (calcareous) material.
2. Poor internal drainage that restricts root growth.
3. A dense, compact layer that inhibits root penetration or spreading.
4. Shallowness to bedrock, sand, or gravel.
5. Drouthiness, strong acidity, or other conditions that restrict crop growth and reduce rooting depth.

**Suggested Annual Maintenance for Alfalfa, Grasses, and Alfalfa-Grass Mixtures**

| Phosphorus-supplying power rating of soil | Yield expected or obtained (tons dry matter per acre) | | |
|---|---|---|---|
| | 5 | 7 | 10 |
| | *Pounds $P_2O_5$ per acre* | | |
| Low | 55 | 77 | 110 |
| Low to medium | 44 | 62 | 88 |
| Medium | 38 | 54 | 77 |
| Medium to high | 33 | 46 | 66 |
| High to medium | 28 | 38 | 55 |

### Annual vs. Infrequent Applications

Applying phosphorus every 2 or 3 years (up to 4 years for alfalfa) is as effective as applying smaller amounts each year and it saves labor. Mixing the fertilizer into the soil by plowing, disking, or chiseling will reduce the likelihood of it being carried off the field through erosion. This may reduce excessive algae growth in lakes and reservoirs but it is probably not important in Illinois streams.

### Illinois Tests for Phosphorus

Illinois laboratories make two tests for phosphorus, referred to as $P_1$ and $P_2$. The $P_1$ test (interpreted on the front of this sheet) measures readily available phosphorus. The $P_2$ test uses a stronger extractant and therefore measures both available phosphorus and phosphorus that has been built up with rock phosphate but has not yet been converted to available form. The $P_1$ test is a better indication of the soil phosphorus supply for this year's crop and also for the next year or two.

The $P_2$ test is used as a guide to the application of rock phosphate (see table at right). The results of this test are necessary for ACP practice payments.

If the $P_2$ test has been built to 50 or above through applications of soluble phosphates, the rating of the $P_2$ test in the table is too low and the suggested application is too high. A $P_1$ test is needed to show the status of available phosphorus.

**Suggested Application of Rock Phosphate Based on the $P_2$ Soil Test**

| $P_2$ test | Rock phosphate for 8 to 10 years |
|---|---|
| | *lb. per acre* |
| Below 20 | 1,500 |
| 20 to 32 | 1,300 |
| 33 to 53 | 1,000 |
| 54 to 75 | 800 |
| Above 75 | No build-up application, but soluble phosphate is needed for wheat |

### Rock Phosphate or More Available Phosphate?

Rock phosphate contains about 30 percent total $P_2O_5$ of which about 1/10 is as available as that in other phosphorus-supplying fertilizers. The most economic use of rock phosphate is related to soil pH and to the amount of alfalfa or clover in the cropping system. **At pH 6.5 or above,** rock phosphate is not likely to be as economical as other sources. **At pH 6.0 to 6.5,** rock phosphate and more readily available forms may be equally profitable if (a) alfalfa, clover, lespedeza, or birdsfoot trefoil is an important part of the cropping system; (b) the soil is inherently moderately acid; and (c) ACP cost-sharing assistance is available. **Below pH 6.0,** there is enough soil acidity to efficiently release phosphorus from phosphate rock, so rock may be used in a soil-buildup program.

### To Convert $P_2O_5$ Figures to Amount of P Contained

Phosphorus fertilizers are added in order to supply phosphorus. However, it has long been the custom to show percentages in terms of $P_2O_5$ content. To find the amount of P in $P_2O_5$, multiply the $P_2O_5$ figure by 0.44.

Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. John B. Claar, *Director*, Cooperative Extension Service, University of Illinois at Urbana-Champaign.

Vocational Agriculture Service
434 Mumford Hall
Urbana, Ill. 61801

I-F-2-12

Soil Test Form D-4

# POTASSIUM (K) — MAPS AND INTERPRETATION

## POTASSIUM-SUPPLYING POWER

## FIELD MAP OF K TEST

## STEPS TO FOLLOW

**1.** *Decide into which group your soil falls* with respect to potassium-supplying power. Illinois is divided into four general regions in terms of inherent potassium-supplying power. These regions are shown on the map of Illinois at left. There are, of course, important differences among the soils within these general regions because of the seven factors listed on the back of this sheet. Soils in the areas of the map shown in solid black are sands.

**2.** *Study the paragraph checked below* together with the field map of K tests which shows the present potassium levels on your test field.

☐ Potassium is below the most profitable level. Potassium applications should, therefore, be large enough to not only meet the needs of the next crop but also to raise the soil test level.

☐ Potassium is at the suggested level. You may broadcast potassium annually or at 2- to 3-year intervals to at least maintain the test level until the field is sampled again.

☐ Potassium is well above the level believed to be needed. Therefore no yield increase is likely from an application of potassium this year.

☐ Potassium is so high that you run the risk of creating problems with other nutrients, especially magnesium.

**3.** *Decide where and how to apply the needed potassium* by consulting the table below. The table is based on tests of samples taken between May 1 and September 30. Samples should never be taken when the soil is frozen. Seasonal adjustments for samples taken before April 30 and after October 1 are as follows: Dark-colored soils — subtract 30; light-colored soils in central and northern Illinois — subtract 45; low potassium-supplying soils south of Illinois Route 16 — subtract 60; fine-textured bottomland soils — subtract 45.

| Soil test range | Estimated percent of maximum possible yield | | Potassium rates to build soil test and to last 2 years (See back of sheet for 3rd and 4th years) | | | |
|---|---|---|---|---|---|---|
| | | | Soils LOW in potassium-supplying power | | Soils MEDIUM to HIGH in potassium-supplying power | |
| | Corn, soybeans, alfalfa, clover | Wheat, oats | $K_2O$ | K | $K_2O$ | K |
| | | | *lb.* | *lb.* | *lb.* | *lb.* |
| 90 or less | 75 or less | 90 or less | 300 | 250 | [These soils are | |
| 91 to 120 | 76 to 81 | 91 to 94 | 270 | 225 | [seldom this low | |
| 121 to 150 | 82 to 90 | 95 to 97 | 240 | 200 | 210 | 175 |
| 151 to 180 | 91 to 93 | 98 or more | 210 | 175 | 180 | 150 |
| 181 to 210 | 94 to 95 | 98 or more | 180 | 150 | 150 | 125 |
| 211 to 240 | 96 to 97 | 98 or more | 150 | 125 | 120 | 100 |
| 241 to 300 | 98 or more | 98 or more | 120 | 100 | See "When to Apply" on back of sheet | |

### Alfalfa or Alfalfa-Grass Seeding Without a Companion Crop (See Back of Sheet for Maintenance Rates)

| K test level | Expected yield: seeding year if spring sown; following year if fall sown | |
|---|---|---|
| | 2 to 3 tons | 3 to 5 tons |
| | *Pounds of $K_2O$ to apply per acre* | |
| 90 or less | 160 | 220 |
| 91 to 120 | 120 | 180 |
| 121 to 150 | 80 | 140 |
| 151 to 180 | 0 | 100 |
| 180 and above | 0 | 0 |

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**Suggested Annual Potassium Maintenance Fertilization for Alfalfa, Grasses, and Alfalfa-Grass Mixtures After Soil Tests Are Built to High Levels**

| Nutrient-supplying power rating of soil (see map on front) | Percent of nutrients to be supplied by fertilization | Yield expected or obtained (tons dry matter per acre) | | |
|---|---|---|---|---|
| | | 5 | 7 | 10 |
| | | Pounds $K_2O$ per acre | | |
| Low | 100 | 250 | 350* | 500* |
| Low to medium | 80 | 225 | 315* | 450* |
| Medium | 70 | 200 | 280 | 400* |
| Medium to high | 60 | 175 | 245 | 350* |
| High to medium | 50 | 150 | 210 | 300 |
| High | 50 | 125 | 175 | 250 |

*Rates above 300 pounds $K_2O$ should be split and applied at two different dates to prevent plant injury.

## INFORMATION TO HELP YOU PLAN A POTASSIUM (K) PROGRAM

### Why Soils Differ in Natural Supply of Potassium

Inherent potassium-supplying power depends mainly on:

1. The amount of clay and organic matter. This influences the exchange capacity of the soil.
2. The degree of weathering of the soil material. This affects the amount of potassium that has been leached out.
3. The kind of clay mineral.
4. Drainage and aeration. These influence the uptake of potassium.
5. pH. Very high calcium and magnesium reduce potassium uptake.
6. The parent material from which the soil formed.
7. Compactness or other conditions that influence root growth.

A soil test goal of 241 to 300 is suggested for all the regions. Rates of potassium suggested in the buildup period and for maintenance on soils that are classified low or medium in potassium-supplying power are larger than those for soils that are classified high.

Recent results show that a few soils respond to potassium applications even at tests above the suggested goal of 241 to 300. Research to identify these soils is continuing. They are likely to be fine-textured, very dark, and imperfectly drained.

Sandy soils are low in potassium-supplying power because they are low in exchange capacity and cannot hold much reserve K. In addition, minerals from which sandy soils develop are low in K.

The silt loams in the "low" area in southern Illinois (claypans) are relatively older soils in terms of soil development and consequently much more of the potassium has been leached out of the root zone. Furthermore, wetness and a platy structure in the upper subsoil may interfere with rooting and with K uptake early in the growing period even though roots are present.

Soils in northeastern Illinois that were formed from medium- to fine-textured till are quite high in potassium by soil test, but restricted drainage may reduce potassium uptake during the early part of the growing season. As a result, those soils with wetness problems have only a medium rating in their ability to supply potassium to crops.

### When to Apply Potassium in the Cropping System

Corn, soybeans, and forage legumes are most sensitive to a potassium shortage. Applications should be timed to meet their needs.

On soils that have a very low potassium test, you may apply the suggested initial applications (even up to 300 pounds of $K_2O$ per acre) at one time or you may apply 2/3 the first year and 1/3 the second year. For the third and fourth years, or until the field is resampled, the following approximate maintenance amounts are suggested: 60 pounds of $K_2O$ per year or 120 pounds to last 2 years; double the amount on fields where silage or hay is removed and no manure returned.

There is no hard-and-fast rule for dividing the potassium over a 4-year cropping period. Broadcast applications every second or third year are as effective as smaller annual applications.

### Safe Limits for Drill Applications

Since potassium salts are very soluble, large amounts cannot safely be placed near the seed. Nitrogen and potassium combined should not exceed about 40 pounds per acre for corn in 40-inch rows through a split boot. Larger amounts are safe through a planter with side placement of the fertilizer away from the seed. No more than 12 pounds should be applied as a pop-up fertilizer in contact with the seed.

Up to 40 pounds of $K_2O$ (33 pounds of K) plus nitrogen is safe through the drill for small grain.

Soybeans are very sensitive to salt injury and no more than 40 pounds of $K_2O$ (33 pounds of K) is suggested for side placement. Broadcast application of all potassium is preferred for soybean. Pop-up placement is discouraged.

## INFORMATION SHEET

## SOIL SAMPLE TEST RESULTS

## ADDITIONAL INFORMATION FOR TEACHERS

**RECOMMENDATIONS:** All fertilizer recommendations are based on information in the 1979-80 Handbook. As to the exact rates and zones of fertilizer application, there is an element of subjective interpretation which is based on experience. The student should use his/her own experience to modify the recommendation to suit the individual operation.

**SPECIAL NOTE:** The area around site 10, where the barnyard was, is sometimes given a different recommendation than the field around it. The old barnyard should be treated as a unit. Any part of the field south and east of site 10 that was **not** part of the barnyard should be treated in the same way as site 1, 9, and 11.

**PROCEDURE:** The students should be encouraged to develop a field map for each test, plotting the recommendations at each sample site. This will aid the student in visualizing the fertility recommendations for the field.

**EXAMPLE:** The sample farm is for class discussion and for an example as to how the forms would be completed and the results analyzed. When discussing the results the students should have a copy of the handout, "Soil Treatments Based on Soil Tests," and Illinois Soil Test Reports D–1, D–2, D–3, and D–4.

Soil Test Form **B**

# SOIL SAMPLE INFORMATION SHEET

**(To accompany soil samples; complete one form for each field)**

DATE September 20, 1981

Brown County

Township Land
Section 12 Qtr. NE
Field I
Acres 66
Samples 22

Tests Desired:
pH X
P-1 X
K X
OM X

TENANT Jack Farming ADDRESS Route 3, Goodland, IL 00101

OWNER Milo Sorghum ADDRESS Fieldcrop, IL 00000

In order that the results of the test may be properly analyzed and interpreted, the following information should be submitted with the samples from each field:

1. Soil type name Drummer, Raub, Parr, Dana.
2. Kind of soil: sandy _____ silt loam X clay _____ muck _____.
3. Is drainage good Parr Dana fair Raub poor Drummer?
4. Has the field been limed recently? Yes When? 1975 Amount per acre 3.3 Ton/Ac North 46 2.0 Ton/Ac South 20
5. Amount of fertilizer applied per acre last year: N None $P_2O_5$ 100 lbs./Ac East 30 200 lbs./Ac West 36 $K_2O$ 150 lbs/Ac East 30 200 lbs/Ac West 36
6. Cropping intentions for next four years, expected yields, and tillage system (plow, chisel, disk, no-till, etc.):

| | | Intended crop | Expected yield | Tillage system |
|---|---|---|---|---|
| This year | 1981 | Corn | 200 bu./Ac. | plow after Corn |
| Next year | 1982 | Soybeans | 60 bu./Ac. | No fall tillage after beans |
| Third year | 1983 | Corn | 200 bu./Ac. | |
| Fourth year | 1984 | Soybeans | 60 bu./Ac. | |

7. How deep do you plow? 7"-9"
8. Are there any special problems? The Drummer soil tends to pond in some areas. There is a 10 percent slope in the Northwest section of the field. The area around Site #10 is where the old barnyard was located.

One sample was taken for every 3 acres of land. Each sample is a composite of 5 cores taken 6"-7" deep from an area about 15 feet square. Note Field map to locate sampling sites and the soil types in the field.

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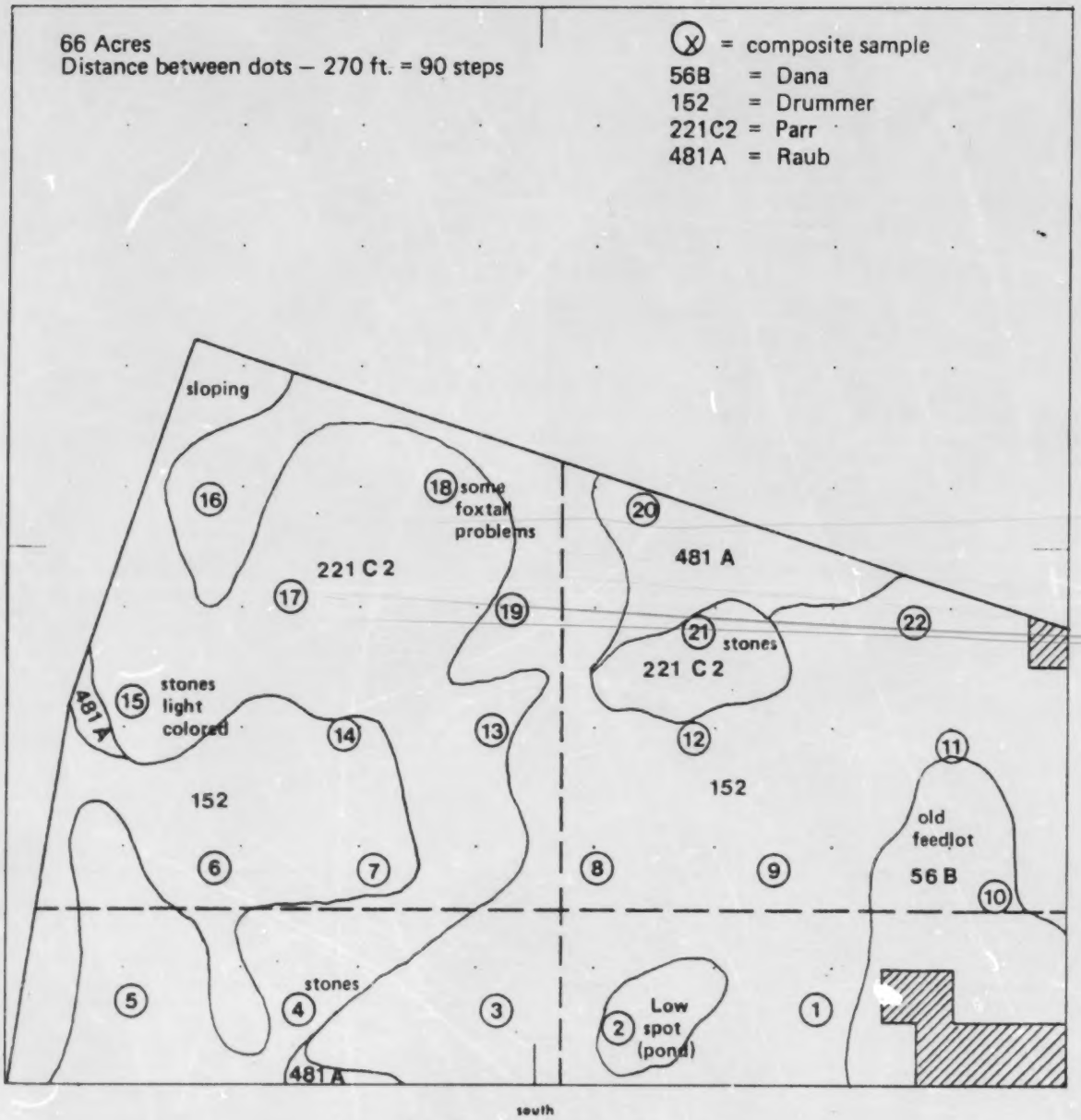
## MAP OF THIS FIELD
**(Number the sample locations)**

Top of map is north




south

Vocational Agriculture Service
434 Mumford Hall
Urbana, Ill. 61801

Soil Test Form D-1

# SOIL TEST REPORT

Brown County

Samples brought in by Jack Farming

Date: September 23, 1981 (received) October 15, 1981 (tested)

Samples tested by J. Jones

Tenant: Jack Farming Address: Route #3 Goodland, IL 00101

Owner: Milo Sorghum Address: Fieldcrop, IL 00000

This report gives you the results of the laboratory tests on your samples.

I suggest that you *keep this report in a permanent folder. Record right on the field maps* the amounts of lime and f tilizer that you apply and the dates when you apply them. This record will help you to interpret the next test on the fi and will also give you a long-term inventory that will show whether soil fertility is being built up, is being maintained, o declining.

| Field and sample number | Acres | pH Test for acidity | $P_1$ Test for available phosphorus | K Test for potassium | Organic matter or soil color | Comments |
|---|---|---|---|---|---|---|
| Field I | 66 | | | | | |
| Sample #1 | | 6.5 | 66 | 429 | 3.2 | |
| 2 | | 6.0 | 135 | 438 | 5.0 | |
| 3 | | 7.7 | 36 | 329 | 4.2 | |
| 4 | | 7.1 | 18 | 272 | 2.1 | |
| 5 | | 6.7 | 21 | 315 | 3.0 | |
| 6 | | 6.5 | 120 | 438 | 5.0 | |
| 7 | | 6.0 | 82 | 325 | 4.5 | |
| 8 | | 6.5 | 68 | 336 | 4.5 | |
| 9 | | 6.2 | 78 | 346 | 5.1 | |
| 10 | | 6.8 | 215 | 1590 | 6.0 | |
| 11 | | 6.4 | 38 | 318 | 3.6 | |
| 12 | | 6.3 | 164 | 585 | 4.5 | |
| 13 | | 6.2 | 40 | 247 | 3.8 | |
| 14 | | 6.3 | 43 | 297 | 4.0 | |
| 15 | | 6.8 | 26 | 311 | 2.6 | |
| 16 | | 6.0 | 54 | 332 | 4.3 | |
| 17 | | 6.6 | 24 | 318 | 2.8 | |
| 18 | | 6.4 | 42 | 346 | 3.4 | |
| 19 | | 6.4 | 93 | 354 | 4.1 | |
| 20 | | 6.3 | 42 | 300 | 4.2 | |
| 21 | | 6.6 | 43 | 453 | 2.7 | |
| 22 | | 6.7 | 49 | 297 | 4.2 | |

Soil tests are only a means to an end. The important thing is how you use the results to plan a better soil-fertility p gram. Planning the most profitable soil treatments after you have the results of the soil tests is not simple, but it is extrem important in determining your profit from farming.

On the back of this sheet, and on the other sheets labeled LIME, PHOSPHORUS, or POTASSIUM, you will find t information that you need to understand the tests so that you can plan a more profitable soil-fertility system. If you have f ther questions, please contact me.

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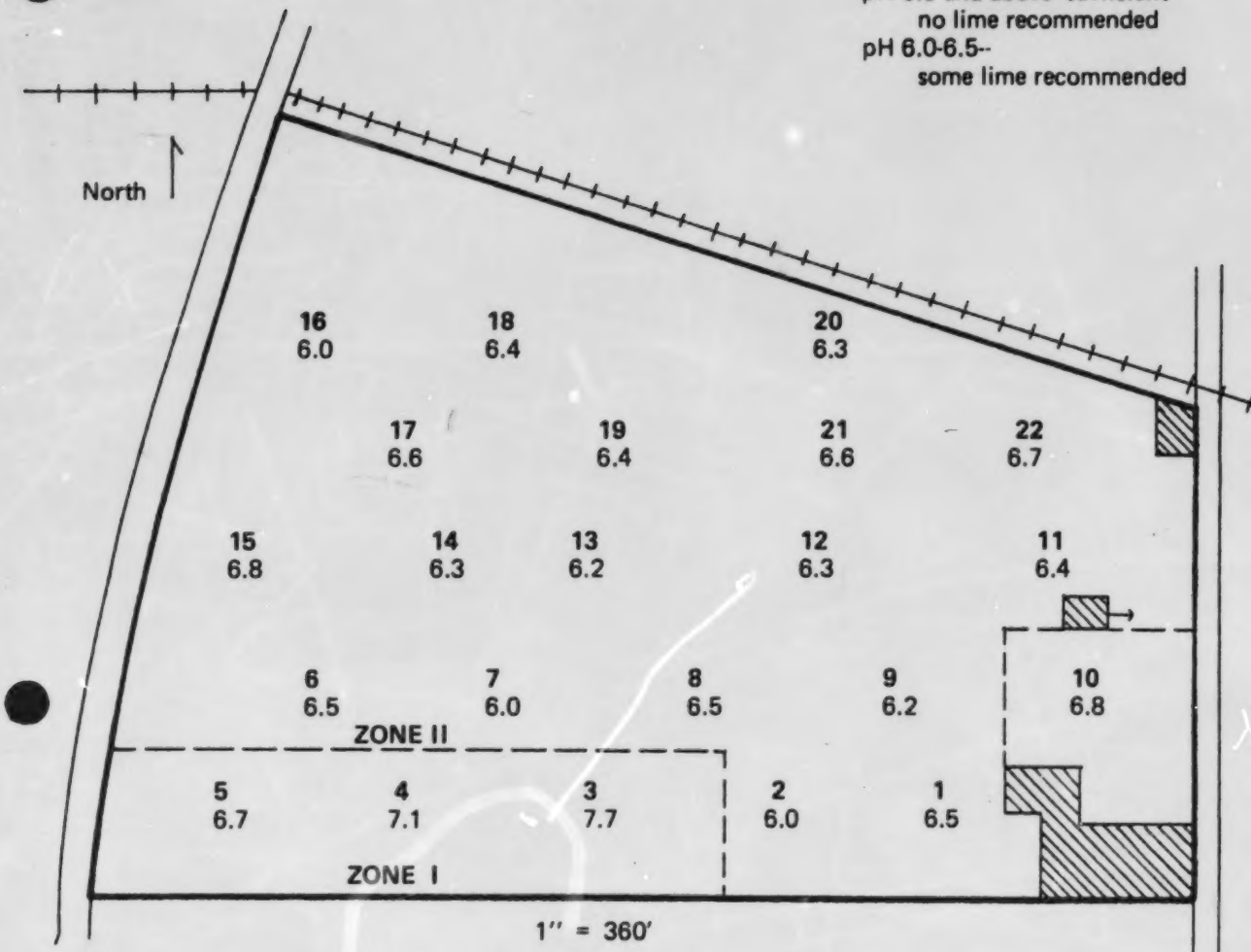
## FIELD 1 66 ACRES

**pH values**

pH 6.6 and above--sufficient
no lime recommended
pH 6.0-6.5--
some lime recommended




Range: 6.0–7.7

Median value: 6.4

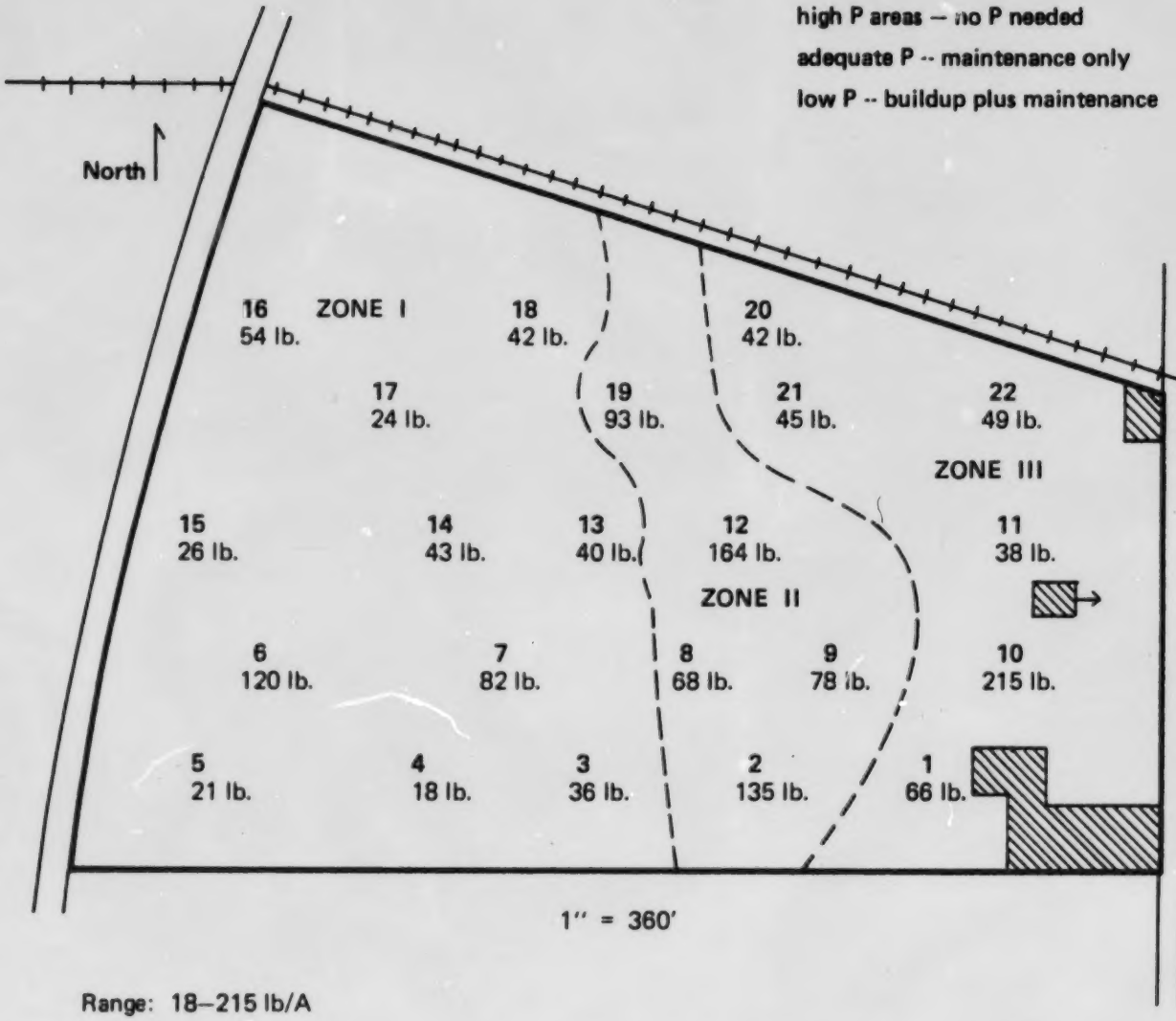
RECOMMENDATION: Zone I------ Do not lime
Zone II----- Apply 2.5 T/A limestone; do not lime barnyard

Assumptions: The quality of lime is such that 1) 95% will pass through 8 mesh screen, 40% will pass through 100 mesh screen, and 2) 90% $CaCO_3$ equivalent

## FIELD 1 66 ACRES

phosphorous test
values given in lb/A

high P areas – no P needed
adequate P -- maintenance only
low P -- buildup plus maintenance




Range: 18–215 lb/A

Median: 47 lb/A

RECOMMENDATION: For corn in 1981, 1983, apply
Zone I – 145 lb/A $P_2O_5$
Zone II – No fertilizer
Zone III – 100 lb/A $P_2O_5$ Do not fertilize the barnyard.

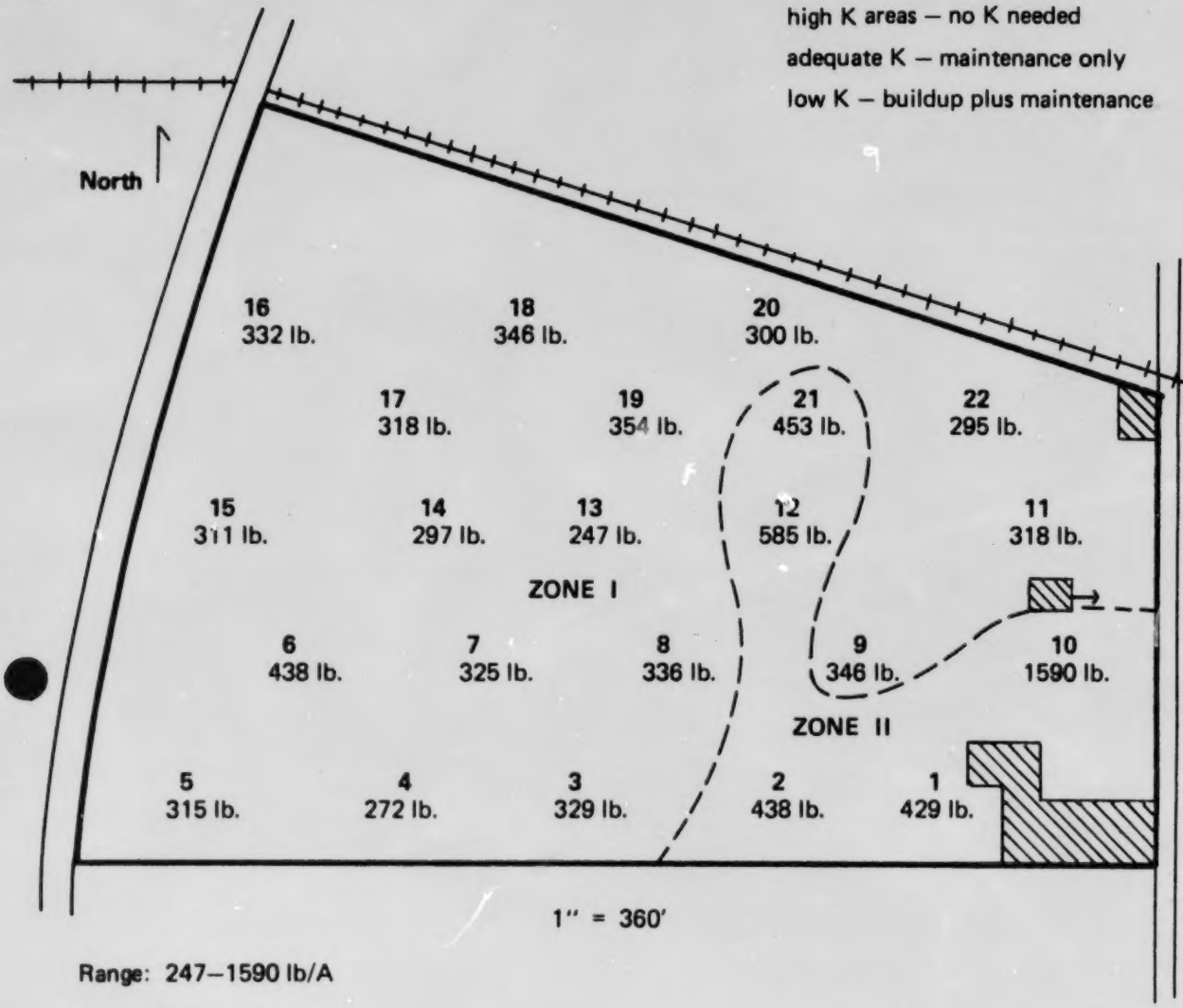
For soybeans in 1982, 1984, apply
Zone I – 115 lb/A $P_2O_5$
Zone II – No Fertilizer
Zone III – 75 lb/A $P_2O_5$ Do not fertilize the barnyard.

Note: The fertility pattern seems to follow the terrain. The knolls have exposed glacial till which is low in phosphorous supplying ability. The low ground tends to be high in phosphorous levels. It is not necessary to fertilize the low ground near site 6 in Zone I.

I-F-2-20

## FIELD 1 66 ACRES

### POTASSIUM TEST
values given in lb/A




Range: 247–1590 lb/A

Median: 330 lb/A

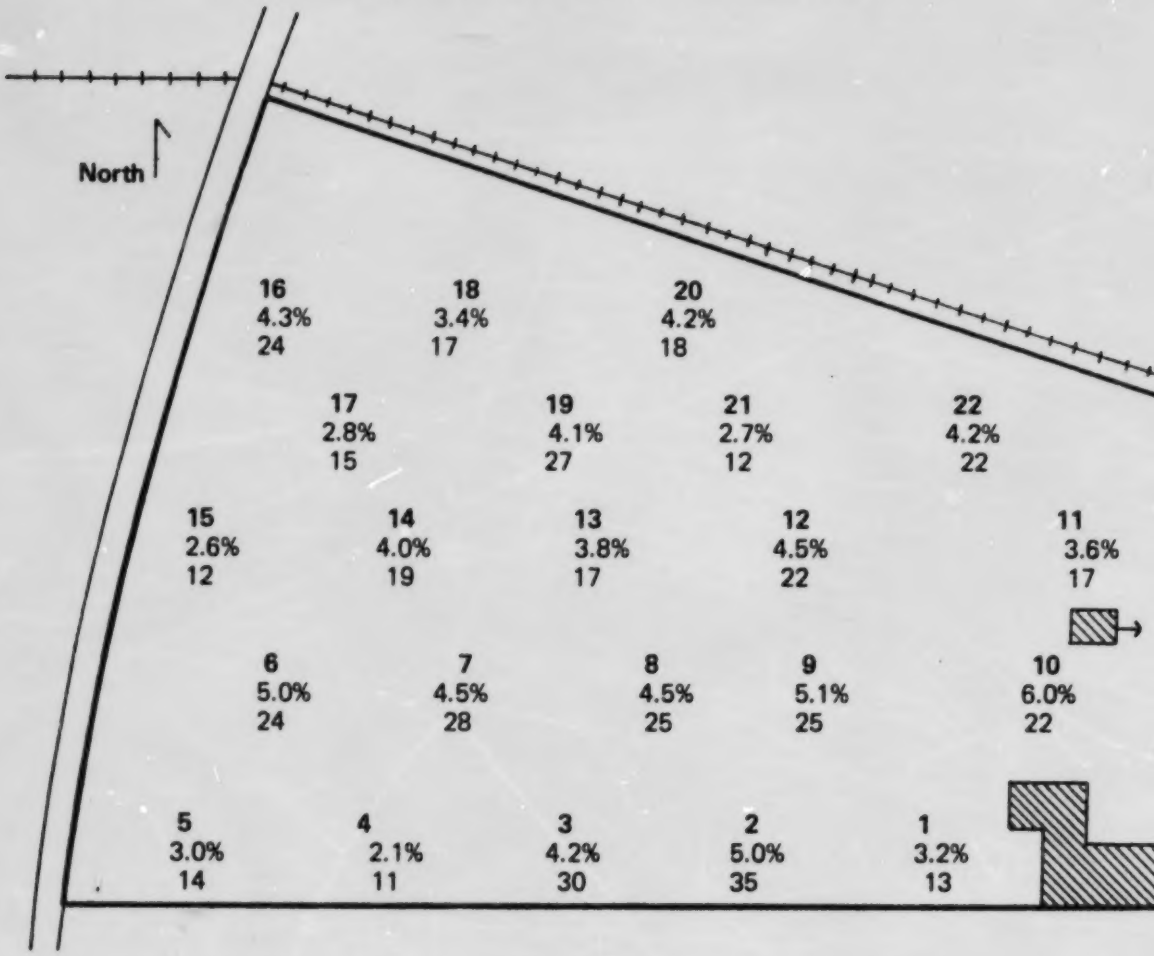
RECOMMENDATION: For corn 1981, 1983, apply
Zone I – 60 lb/a $K_2O$
Zone II – No fertilizer

For soybeans, 1982, 1984, apply
Zone I – 80 lb/A $K_2O$
Zone II – No fertilizer

Note: Soils are high in potassium-supplying ability. Soil test values are based on an ammonium acetate extraction read on a flame emission spectrophotometer.

## FIELD 1 66 ACRES

**% Organic Matter and**
**Cation Exchange Capacity (CEC) in meq/100g of soil**



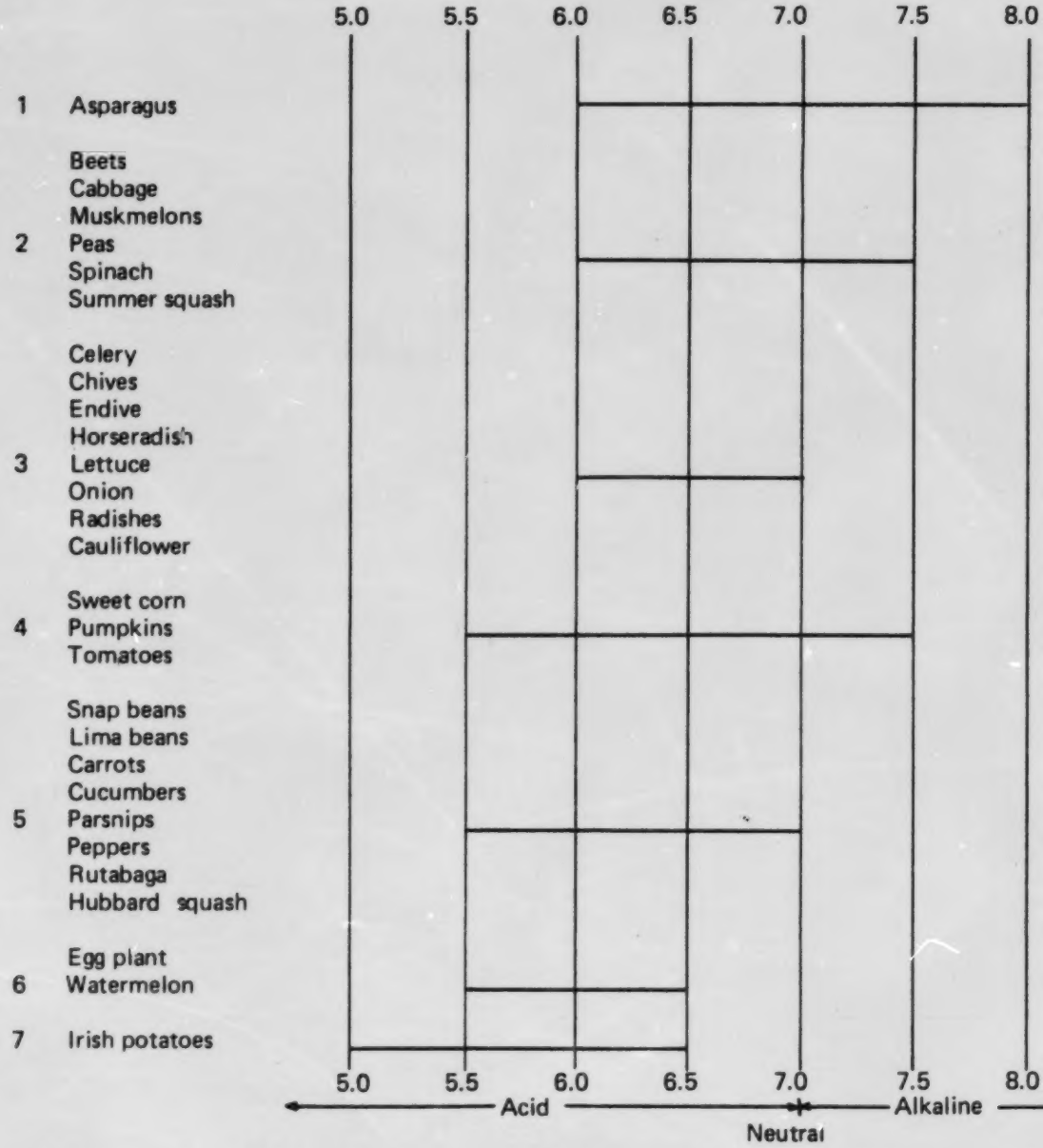

1" = 360'

Range: % OM 2.1–6.0
CEC 11–35

Median: % OM 4.1
CEC 21

## INFORMATION SHEET

### OPTIMUM pH FOR VEGETABLE CROPS




Note: Except in special cases the objective of a liming program for vegetable crops should be to keep the pH between 6 and 6.5, as this range is satisfactory for most vegetables.

Potatoes are sometimes grown in soil with a pH of 5 or lower in order to avoid serious damage from scab disease, which increases with increasing pH.

Cabbage plants are sometimes grown close to or about neutral in order to reduce damage from club root disease.

## INFORMATION SHEET

## SOIL TEST INTERPRETATION

| | | Fertility Requirement Groups* | | | |
|---|---|---|---|---|---|
| | | I | II | III | IV |
| | | Tomatoes<br>Potatoes<br>Peppers<br>Egg plant<br><br>Cabbage<br>Cauliflower<br>Broccoli<br>Brussel sprouts<br><br>Cucumbers<br>Melons<br>Squash<br>Pumpkin | Asparagus<br>Onions<br>Sweet Corn<br><br>Spinach<br><br>Lettuce<br><br>Sweet Potatoes<br>Horseradish | Carrots<br>Parsnips<br>Beets<br><br>Radishes<br>Turnips | Bea<br>Pea |
| P Soil Test** | | | | | |
| $P_1$ | $P_2$ | $P_2O_5$ Requirement in pounds per acre | | | |
| 8 | 20 | 300 | 260 | 160 | 8 |
| 12 | 30 | 300 | 240 | 140 | 6 |
| 16 | 40 | 300 | 220 | 120 | 4 |
| 20 | 50 | 280 | 200 | 100 | 2 |
| 24 | 60 | 260 | 180 | 80 | 2 |
| 28 | 70 | 240 | 140 | 60 | 2 |
| 32 | 80 | 220 | 120 | 40 | 2 |
| 36 | 90 | 200 | 100 | 40 | 2 |
| 40 | 100 | 180 | 80 | 40 | 2 |
| 44 | 110 | 160 | 40 | 40 | 2 |
| 48 | 120 | 140 | 20 | 40 | 2 |
| 52 | 130 | 120 | 20 | 40 | 2 |
| 56 | 140 | 100 | 20 | 40 | 2 |
| 60 | 150 | 80 | 20 | 40 | 2 |
| 64 | 160 | 60 | 20 | 40 | 2 |
| 68 | 170 | 40 | 20 | 40 | 2 |
| K Soil Test** | | $K_2O$ Requirement in pounds per acre | | | |
| 40 | | 260 | 260 | 200 | 8 |
| 60 | | 240 | 240 | 180 | 6 |
| 80 | | 220 | 220 | 160 | 4 |
| 100 | | 200 | 200 | 140 | 2 |
| 120 | | 200 | 200 | 120 | 4 |
| 140 | | 180 | 180 | 100 | 2 |
| 160 | | 160 | 160 | 100 | 2 |
| 180 | | 140 | 140 | 100 | 2 |
| 200 | | 120 | 120 | 100 | 2 |
| 220 | | 120 | 120 | 100 | 2 |
| 240 | | 100 | 100 | 100 | 2 |
| 260 | | 80 | 80 | 100 | 2 |
| 280 | | 80 | 60 | 100 | 2 |
| 300 | | 80 | 40 | 100 | 2 |
| 320 | | 80 | 20 | 100 | 2 |

* Home gardens may be treated as if all crops were in Group I.

** Soil tests by Illinois Soil Testing System.

## WORKSHEET 1

### SOIL pH

1. Name the three major elements necessary for plant growth.

   a. _____

   b. _____

   c. _____

2. Why do soils become acid or alkaline?

   _____

   _____

   _____

3. The most important single chemical characteristic of a soil is the degree of _____ or _____.

4. The soil reaction is indicated by _____ .

5. A soil with a pH of 6.0 is considered _____ . Alkaline soils have a pH greater than _____.

6. The most desirable pH range for farm crops is _____ to _____.

7. List four crops that grow best in the following pH ranges:

| pH | 5.0–5.5 | 5.5–6.0 | 6.0–6.5 | 6.5–7.5 |
|---|---|---|---|---|
| a. | _____ | _____ | _____ | _____ |
| b. | _____ | _____ | _____ | _____ |
| c. | _____ | _____ | _____ | _____ |
| d. | _____ | _____ | _____ | _____ |

8. The best way to keep check on soil acidity levels is by _____.

9. List the three most commonly used liming materials for neutralizing soils.

   a. _____

   b. _____

   c. _____

## WORKSHEET 2

## PHOSPHORUS AND POTASSIUM

1. Name nine common sources of phosphorus and the approximate percentage of phosphorus.

| | Name | % |
|---|---|---|
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |
| d. | _____ | _____ |
| e. | _____ | _____ |
| f. | _____ | _____ |
| g. | _____ | _____ |
| h. | _____ | _____ |
| i. | _____ | _____ |

2. List six sources of potassium and their approximate percentage.

| | Name | % |
|---|---|---|
| a. | _____ | _____ |
| b. | _____ | _____ |
| c. | _____ | _____ |
| d. | _____ | _____ |
| e. | _____ | _____ |
| f. | _____ | _____ |

3. The three forms of potassium in soil are:

a. _____

b. _____

c. _____

4. What effect does pH have on the availability of phosphorus and potassium?

_____

_____

5. A survey of fields in Illinois showed about 16% were unrealistically high in their $P_1$ test. What are some possible explanations for these results?

_____

_____

_____

6. What is the phosphorus supplying power of the soil in your region of Illinois?

_____

7. To increase the $P_1$ test one pound, you must apply _____ pounds of $P_2O_5$ per acre.

8. What is the potassium supplying power of the soil in your region of Illinois?

_____

9. To increase the soil potassium test one pound, you must apply how many pounds of $K_2O$?

_____

**TEACHER'S KEY**
**WORKSHEET 1**

**SOIL pH**

1. Name the three major elements necessary for plant growth.

   a. Nitrogen

   b. Phosphorus

   c. Potassium

2. Why do soils become acid or alkaline?

   Fluctuations in hydrogen ions in the soil.

3. The most important single chemical characteritic of a soil is the degree of acidity or alkalinity.

4. The soil reaction is indicated by pH scale.

5. A soil with a pH of 6.0 is considered acid and alkaline soils have a pH great than 7.0.

6. The most desirable pH range for farm crops is 6.0 to 7.0.

7. List four crops that grow best in the following pH ranges: (Refer to Transparency 33)

| pH | 5.0–5.5 | 5.5–6.0 | 6.0–6.5 | 6.5–7.5 |
|---|---|---|---|---|
| a. | | | | |
| b. | | | | |
| c. | | | | |
| d. | | | | |

8. The best way to keep check on soil acidity levels is by soil testing.

9. List the three most commonly used liming materials for neutralizing soils.

   a. Limestone–Ag. Lime

   b. Superphosphate

   c. Calcium Nitrate

   Calcium sulfate, Calcium cyanamid

TEACHER'S KEY
WORKSHEET 2

## PHOSPHORUS AND POTASSIUM

1. Name nine common sources of phosphorus and the approximate percentage of phosphorus.

| | Name | % |
|---|---|---|
| a. | Superphosphate | 16–22 |
| b. | Triple superphosphate | 42–50 |
| c. | Liquid phosphoric acid | 54 |
| d. | Nitric phosphate | 10–22 |
| e. | Colloidal phosphate | 20 |
| f. | Basic slag | 8–12 |
| g. | Ammonium phosphate | 20–39 |
| h. | Monophosphate | 48 |
| i. | Diammonium phosphate | 48–53 |

2. List six sources of potassium and their approximate percentage.

| | Name | % |
|---|---|---|
| a. | Potassium chloride (nuriate) | 60 |
| b. | Potassium sulfate | 50 |
| c. | Potassium nitrate | 44 |
| d. | Potassium-magnesium sulfate | 22 |
| e. | Potassium-sodium nitrate | 14 |
| f. | Potassium phosphate | 48 |

3. The three forms of potassium in soil are:

a. Soil solution

b. Exchangeable K

c. Storehouse form

4. What affect does pH have on the availability of phosphorus and potassium?

Acid and alkaline conditions limit phosphorus.

acid conditions limit potassium.

5. A survey of fields in Illinois showed about 16% were unrealistically high in their $P_1$ test. What are some possible explanations for these results?

Poor sampling procedures

Improper fertilizer applications

May represent only a small area in the field.

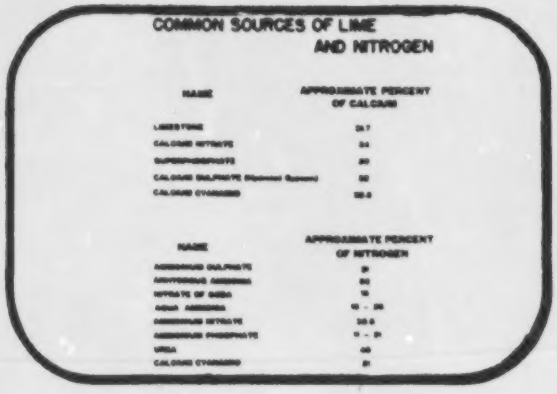
6. What is the phosphorus supplying power of the soil in your region of Illinois?

7. To increase the $P_1$ test one pound, you must apply 9 pounds of $P_2O_5$ per acre.

8. What is the potassium supplying power of the soil in your region of Illinois?

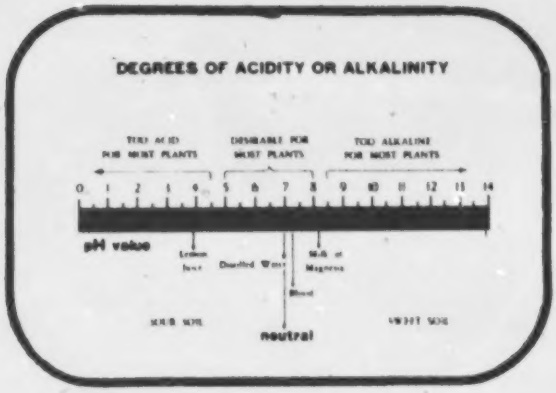
9. To increase the soil potassium test one pound, you must apply how many pounds of $K_2O$?

4




1. Some of the main factors to consider in selecting liming materials are neutralizing power, fineness, and price.

When deciding on which source of nitrogen fertilizer to buy, be sure to consider the following factors: (1) the availability of nutrients contained in the different fertilizer materials; (2) the comparative cost per pound of available nutrients; (3) the effect of the fertilizer materials upon soil reaction--pH value, etc.; and (4) the physical nature of the fertilizer material as it relates to the method and ease of application. Perhaps the most important point to keep in mind in our present price squeeze is the cost per pound of nitrogen from each of the various sources. Pound per pound, available nitrogen supplied by one carrier, or form, is about as effective as that supplied by another.

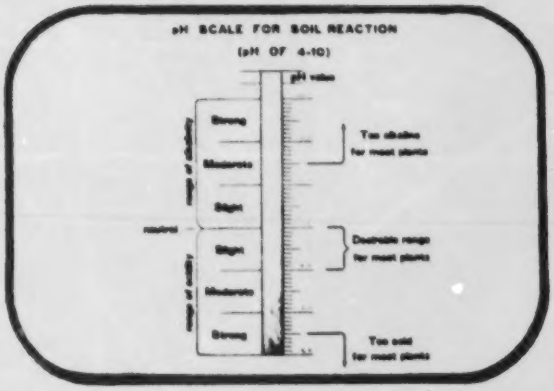



2. This transparency relates pH to some common terms. Note the pH of lemon juice, blood, and milk of magnesia on the scale and the general pH range for most crops. pH values above 8.5 are too alkaline for most plants, and pH values below 5 are too acidic for most plants. Alkaline soils have pH's above 7.. Acidic soils have a pH below 7.

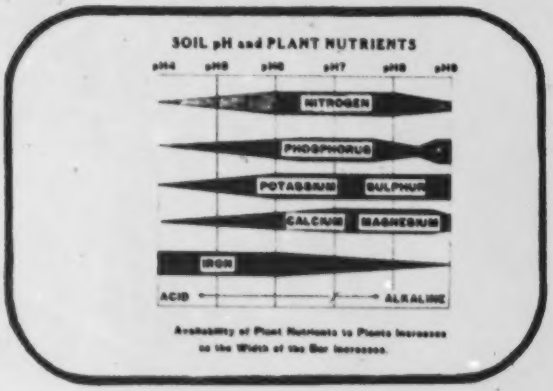
To become better acquainted with pH, the taste of the following items can be considered:

The lemon juice put in iced tea is acidic--it has a "sour" taste. Lemon juice has a pH of about 4. Acid soils are sometimes called "sour". Persons having a tooth pulled, or a cut in their mouth, recall that blood has a salty taste. The pH of blood is a little over 7, so that it is slightly alkaline. The milk of magnesia taken for an upset stomach has a pH of about 8, so that it is more alkaline (basic) than blood, and it tastes "sweeter" than lemon juice. Alkaline soils are sometimes called "sweet". Most agronomists, however, prefer to use the terms "acidic" or "alkaline" rather than "sour" and "sweet".

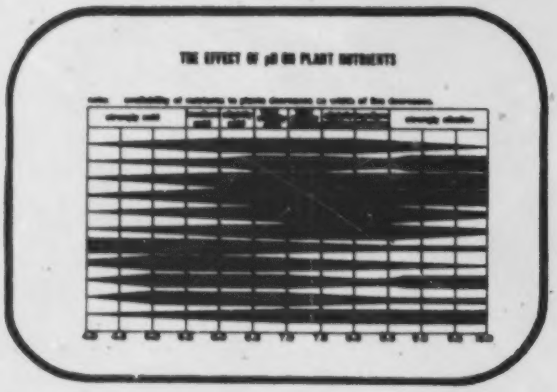
Examples of the extreme ranges of the pH scale would be as follows: The pH of most common dry drain cleaners is around 12. These products are alkaline. The battery acid in a car battery has a pH value of about 2. Battery acid is obviously acidic. The distilled or "bottled" water for sale in stores is neutral--that is it is neither acidic nor alkaline--this water has a pH of 7.




3. The most desirable pH range for farm crops is 6.0 - 7.0. Different kinds of plants, however, grow on soils with different pH values. For example, alfalfa does best on soils slightly acid to slightly alkaline; whereas, potato will grow on strongly acid soils.




4. The availability of essential plant nutrients is related to pH. Note the difference in the availability of iron and calcium as pH changes.



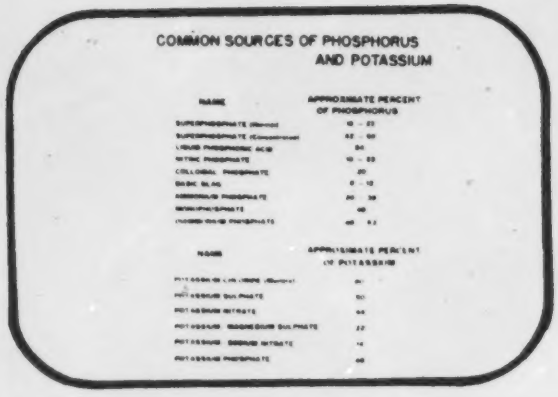
5. This transparency illustrates nutrient availability as influenced by pH. As the width of the nutrient line decreases, the availability of the nutrient decreases. Note how potassium is practically non-available at pH 4.5, but is little affected from pH 7-10. Notice how pH affects the availability of nitrogen, phosphorus, iron, and zinc in the soil pH range of 5-8.5. Acidic conditions limit or decrease the availability of nitrogen and phosphorus. Iron and zinc are little affected under slightly acidic conditions. However, notice the decreased availability of iron and zinc in the alkaline pH range of 7-8.5.

6. Different kinds of plants have the ability to grow and produce on soils with different soils pH values. Some grow only in acid soils, while most crop plants do best on moderately to slightly acid soils. Other plants grow better on slightly acid to slightly alkaline soils.

## PH FERTILITY STATUS OF SAMPLED FIELDS

| pH | Percent of fields | Evaluation |
|---|---|---|
| Below 5.0 | 2 | Manganese toxicity is common below 5.0. |
| 5.1–5.5 | 11 | Needs lime for all crops. Unsuited without liming to grow alfalfa or clover. pH 5.6–6.0 is slightly low for corn and soybeans. |
| 5.6–6.0 | 21 | |
| | (34) | |
| 6.1–6.5 | 30 | Optimum pH. |
| 6.6–7.0 | 22 | |
| | (52) | |
| 7.1–7.5 | 11 | Alkaline. Watch for manganese deficiencies in soybeans and oats, and iron deficiencies in Wayne soybeans. |
| Above 7.5 | 3 | |
| | (14) | |

7. A 3-year survey of 1,706 fields in corn and soybeans in 74 counties was conducted by the University of Illinois Agronomy Department. The results are shown in this transparency and indicates that many liming programs are being short-changed on a growing number of Illinois farms. The use of nitrogen fertilizer has rapidly increased, but the tonnage of limestone has not kept pace. It requires about four pounds of lime to neutralize the acidity of one pound of nitrogen applied as ammonia or urea and as much as nine pounds of lime to neutralize the acidity resulting from one pound of nitrogen as ammonium sulfate. A soil test every four years is the best way to keep check on soil acidity levels.

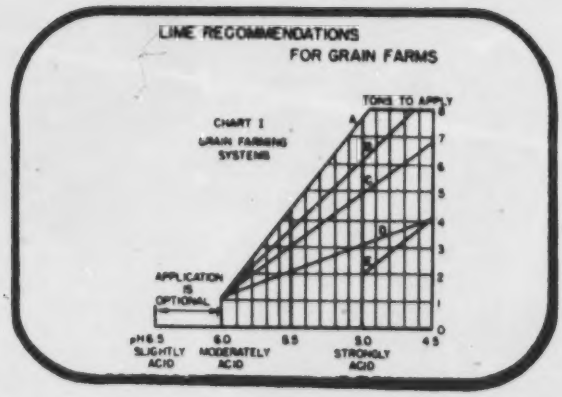



8. The availability of inorganic phosphorus is largely determined by the following factors: (1) soil pH; (2) soluble iron, aluminum, and manganese; (3) presence of iron--, aluminum--, and manganese--containing minerals; (4) available calcium and calcium minerals; (5) amount and decomposition of organic matter; and (6) activities of microorganisms. The first four of these factors are interrelated because their effects are largely dependent upon soil pH.

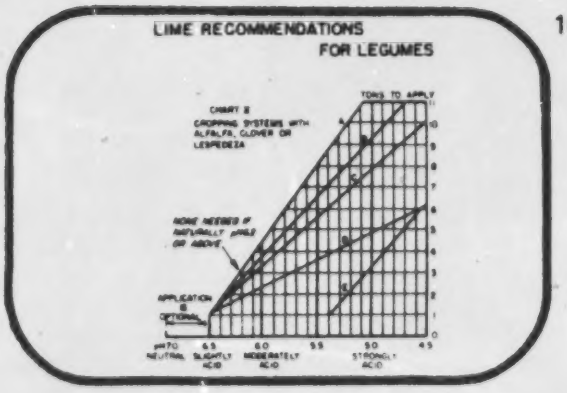
The general trend by farmers is to use a soluble form of phosphorus fertilizers. Rock phosphate, which was earlier used, is not likely to be as economical as other sources at soil pH 6.0 and above. The amount of alfalfa or clover in the cropping system may also affect this decision; but most farmers prefer fertilizer that is more readily available to plants.

Potassium occurs in the soil in three main forms: (1) in the soil solution, (2) as exchangeable K, and (3) in the storehouse form. The K in the soil solution is used by plants. The exchangeable K is held on the outside of the clay minerals and the soil humus; the storehouse form of K is held in the interior of the clay. As K in the soil solution is used by plants, the exchangeable K on the clay easily goes into the solution and, in turn, the K from inside the clay (storehouse form) slowly moves to the outside of the clay thus becoming exchangeable. During the time of the year when crops are not growing, K continues to move from the storehouse to build up the supply of exchangeable and soil solution K.

9. 1. Use Chart I for a grain farming system.
   2. Decide which soil class fits your soil--
      A. Silty clays and silty clay loams (dark).
      B. Silty clays and silty clay loams (light and medium). Silt and clay loams (dark).
      C. Silt and clay loams (light and medium), sandy loams (dark), loams (dark and medium).
      D. Loams (light), sandy loams (light and medium), sands.
      E. Muck and peat.
   3. Find your soil's pH along the bottom of the chart.
   4. Follow up the vertical line until it intersects the diagonal line A, B, C, D, or E that fits your soil.
   5. Read the suggested rate of application along the right side of the chart that you are using.



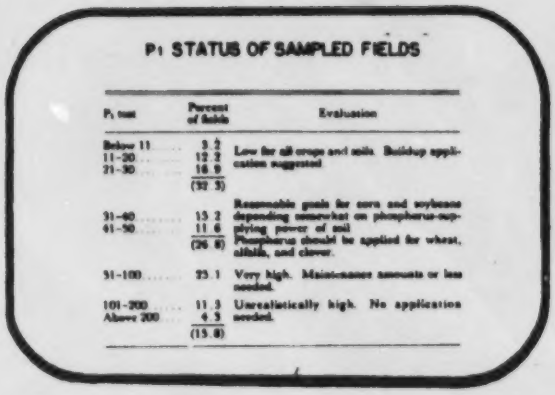

10. 1. Use Chart II for a cropping system with alfalfa, clover, or lespedeza.
   2. Decide which soil class fits your soil--
      A. Silty clays and silty clay loams (dark).
      B. Silty clays and silty clay loams (light and medium). Silt and clay loams (dark).
      C. Silt and clay loams (light and medium) sandy loams (dark), loams (dark and medium).
      D. Loams (light), sandy loams (light and medium), sands.
      E. Muck and peat.



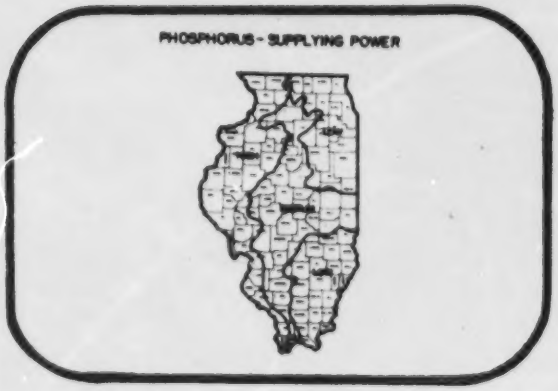
3. Find your soil's pH along the bottom of the chart.
4. Follow up the vertical line until it intersects the diagonal line A, B, C. D, or that fits your soil.
5. Read the suggested rate of application along the right side of the chart that you are using.

11. A 3-year survey of 1,706 fields in corn and soybeans in 74 counties showed the following phosphorus fertility status. It was conducted by the University of Illinois Agronomy Department.

About one-third of the fields (32.3 percent) are definitely low in available phosphorus, over one-fourth (26.8 percent) are near suggested levels, 40.9 percent are above suggested levels and, of those, 15.8 percent are unrealistically high. Some of the very high tests may represent only the small area in the field that was sampled rather than the entire field. Extremely high tests may be caused by an old manure pile or burning of brush or corncobs.




12. Illinois has been divided into four regions in terms of inherent phosphorus-supplying power of the soil below the plow layer in dominant soil types.




High phosphorus-supplying power means:

a. The amount of available phosphorus ($P_1$ test) in the subsoil is relatively high.

b. The conditions are favorable for good root penetration and branching in the subsoil.

Low phosphorus-supply power may be caused by one or more of the following factors:

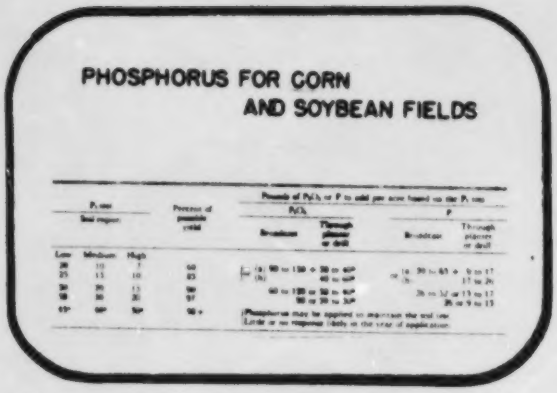
a. A low supply of available phosphorus in the subsoil because (1) the parent material was low in phosphorus; (2) phosphorus was lost in the soil-forming process; or (3) the phosphorus is made unavailable by high pH (calcareous) material.

b. Poor internal drainage that restricts root growth.

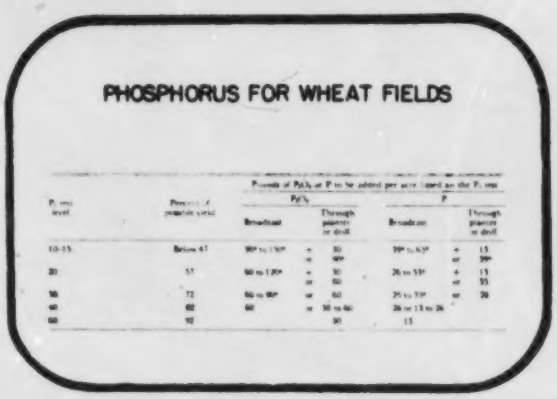
c. A dense, compact layer that inhibits root penetration or spreading.

d. Shallowness to bedrock, sand, or gravel.

e. Drouthiness, strong acidity, or other conditions that restrict crop growth and reduce rooting depth.

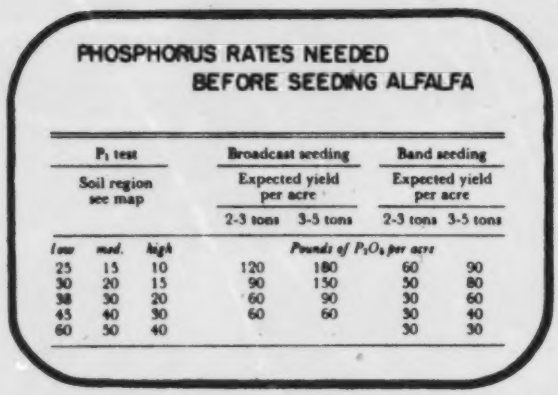



13. Broadcast applications at low $P_1$ te
levels provide for considerable build-up
Drill applications do not. Where there
range in the amount suggested under the
heading "Broadcast," the larger figure
give a quick increase in $P_1$ test, the sm
figure will give only a small increase.



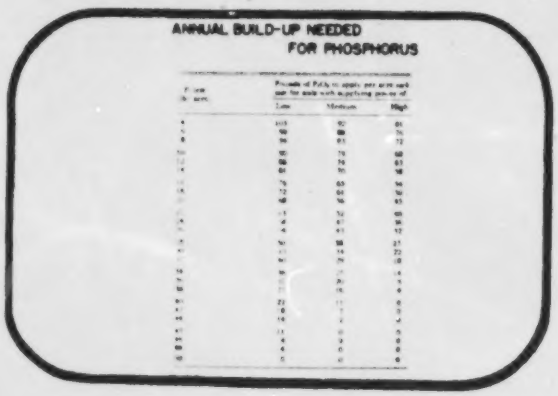

14. Note that the percent of possible yie
for wheat is lower than for corn at the v
$P_1$ test levels. Wheat requires a large
of readily available phosphorus in the fa
Phosphorus stimulates early growth, pr
winter survival, and helps make the you
plant capable of high yield in the followi
year.

If you do not have the results of a P
test, apply 30 to 60 pounds of available
(13 to 26 P) through the drill or broadca
about 60 to 120 pounds $P_2O_5$ (26 to 53 po
P).




| $P_1$ test Soil region see map | | | Broadcast seeding Expected yield per acre | | Band seeding Expected yield per acre | |
|---|---|---|---|---|---|---|
| | | | 2-3 tons | 3-5 tons | 2-3 tons | 3-5 tons |
| *low* | *med.* | *high* | *Pounds of $P_2O_5$ per acre* | | | |
| 25 | 15 | 10 | 120 | 180 | 60 | 90 |
| 30 | 20 | 15 | 90 | 150 | 50 | 80 |
| 38 | 30 | 20 | 60 | 90 | 30 | 60 |
| 45 | 40 | 30 | 60 | 60 | 30 | 40 |
| 60 | 50 | 40 | | | 30 | 30 |

15. Apply all phosphorus at seeding tim
broadcast part of it with potassium. Fo
seeding reserve a minimum of 30 pound
$P_2O_5$ per acre. For broadcast seeding,
broadcast all the phosphorus with potass
preferably after primary tillage and bef
final seedbed preparation.




16. Research has shown that it requires
an average for Illinois soils, nine pound
$P_2O_5$ per acre to increase the $P_1$ soil te
one pound. Therefore, the recommende
rate of build-up phosphorus is equal to:
soil test goal minus the actual soil test
multiplied by nine. The amount of phosp
rus is equal to: the soil test goal minus
actual soil test value multiplied by nine.
amount of phosphorus recommended for
up over a four-year period for various s
test levels is shown in this transparency

**POTASSIUM STATUS OF SAMPLED FIELDS**

| K test | Percent of fields | Evaluation |
|---|---|---|
| Below 121 | 3.4 | Very low; soils need broadcast applications for buildup. |
| 121-180 | 13.0 | |
| | 16.4 | |
| 181-240 | 18.1 | Slightly low. |
| 241-300 | 21.9 | Optimum. Maintenance applications only needed. |
| 301-400 | 24.0 | |
| | 45.9 | |
| 401-800 | 14.4 | Very high. No K needed for at least two years. |
| 801-1,100 | 2.6 | Unrealistically high. |
| Above 1,100 | 3.4 | Unrealistically high. |
| | 19.6 | |

17. A 3-year survey of 1,706 fields in co and soybeans in 74 counties showed the fo lowing potassium fertility status. It was ducted by the University of Illinois Agron Department.

About 16.4 percent of the fields are to very low in potassium for all crops, 1 percent slightly low, and 19.6 percent ar unnecessarily high. Some of the highest results for potassium may have been foun small areas where some residue had bee burned.

Research at a few locations shows re sponses of corn to potassium at soil tests above 241. At present fertilizer prices f ers may choose to aim for a test of 300 r than 241.

**POTASSIUM-SUPPLYING POWER**

18. Illinois is divided into four general r gions based on potassium-supplying powe There are, of course, important differenc among soils within these general regions because of differences in the seven factor listed below:

Inherent potassium-supplying power depends mainly on:

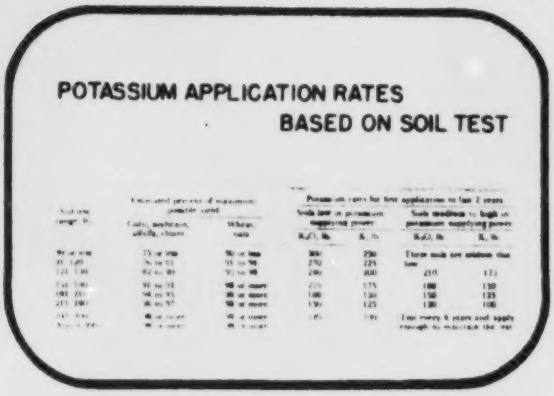
a. The amount of clay and organic matte This influences the exchange capacity the soil.
b. The degree of weathering of the soil material. This affects the amount of potassium that has been leached out.
c. The kind of clay mineral.
d. Drainage and aeration. These influe the uptake of potassium.
e. pH. Very high calcium and magnesiu reduce potassium uptake.
f. The parent material from which the s formed.
g. Compactness or other conditions that fluence root growth.

19. Decide where and how to apply th
potassium by using your soil test ran
crop being grown. This table is base
tests of samples taken between May 1
September 30.

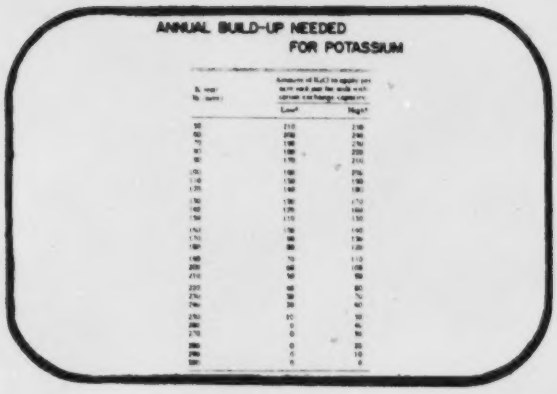
NOTE: Samples should never be take
the soil is frozen. Soil tests are mos
liable when taken during the growing
Seasonal adjustments for samples tak
April 30 and after October 1 are as fo

Dark-colored soils--subtract 30.
Light-colored soils in central and nor
Illinois--subtract 45.
Low potassium-supplying soils south
Illinois Route 16--subtract 60.
Fine-textured bottomland soils--subtr

**POTASSIUM APPLICATION RATES BASED ON SOIL TEST**



**ANNUAL BUILD-UP NEEDED FOR POTASSIUM**



20. Research has shown that it requi
the average four pounds of $K_2O$ to inc
the soil test one pound. Therefore, t
ommended rate of potassium applicati
increasing the soil test value to the d
goal is equal to: soil test goal minus
actual soil test value multiplied by fo

## TEACHER'S KEY TO SAMPLE TEST QUESTIONS

## APPLYING SOIL SAMPLE TEST RESULTS

### TRUE(+)–FALSE(0)

+ 1. A soil with a pH of 7.5 is basic in reaction.

0 2. Nitrogen is one of the major elements tested for in agricultural soils.

0 3. A fertile soil is always a productive soil.

+ 4. Nutrient balance is an important principle in soil fertility.

0 5. A soil with a pH of 7.0 is acid in reaction.

0 6. Acid soils are bad for all crops.

0 7. Fixed soil P is available for plant growth.

+ 8. You should learn all you can about a field before you walk that field to diagnose its problems.

+ 9. In problem fields, the problem area should be sampled separately from the rest of the field.

+ 10. Different soil types have different P and K supplying power.

### COMPLETION

1. The development of a soil fertility program should begin with soil test.
2. Potassium is a major plant nutrient. The other two are nitrogen and phosphorus.
3. The most widely used fertilizer K source is Potash–Muriate.
4. Potassium sulfate contains 41 percent $K_2O$. (50 x .83) convert K to $K_2O$)
5. The primary source of soil P is either Triple Super or Diammonium Phosphate.
6. About 20 – 30 percent of applied P is available for the current crop.
7. To convert P to $P_2O_5$, multiply by 2.29. ($P_2O_5$ to P x .44)
8. The most desirable pH range for farm crops is 6.0 to 7.0.
9. To increase the $P_1$ test one pound, you must apply 9 pounds of $P_2O_5$ per acre.
10. To increase the K test one pound, you must apply 4 pounds of $K_2O$ per acre.

The remaining questions pertain to the Soil Test Report.

11. How many samples were taken? 7

12. The results are based on expected yields per acre for what two crops?

corn and soybeans

13. The samples were tested by A. Adams.

14. The % organic matter for sample 5 is 5.0.

15. The soil texture contained in this sampled field is silt loam.

16. The number of acres in this field is 20.

17. The yield goal for soybeans is 50.

18. The field was limed in what year? 1974.

19. Sample number 1 was taken in the old barnyard.

20. The pH for sample number 3 is 6.8.

21. The two soil types contained in this field are Dana and Drummer.

**ESSAY QUESTIONS**

Record the fertility recommendations for the following field soil test results:

A. Recommendation for Lime

| | |
|---|---|
| Goal pH 6.5 – 7.0 | Apply about 2 ton/acre in Zone II<br>Do not apply any in Zone I |

B. Recommendation for Phosphorus

| | |
|---|---|
| Med. supplying power<br>40 – 50 | Apply 100 – 120 lbs. $P_2O_5$/acre broadcast plus 20 lbs. through the planter. Avoid the feedlot and pond area. |

C. Recommendation for Potassium

| | |
|---|---|
| Med. to high supplying power | Apply 200 – 220 lbs. of $K_2O$/acre in Zone II and apply 60 lbs. of $K_2O$/acre in Zone I for maintenance. |

Soil Test Form **B**

# SOIL SAMPLE INFORMATION SHEET

**(To accompany soil samples; complete one form for each field)**

DATE _____

Blueboy County

Township Flat
Section 2 Qtr. NW
Field 1
Acres 20
Samples 7

Tests Desired:
pH X
P-1 X
K X
OM X

TENANT Tom Test ADDRESS Testville, IL

OWNER Same ADDRESS Same

In order that the results of the test may be properly analyzed and interpreted, the following information should be submitted with the samples from each field:

1. Soil type name Dana, Drummer.
2. Kind of soil: sandy ____ silt loam X clay ____ muck ____.
3. Is drainage good X fair ____ poor ____?
4. Has the field been limed recently? Yes When? 1974 Amount per acre 3 Ton.
5. Amount of fertilizer applied per acre last year: N 125 $P_2O_5$ 100 $K_2O$ 100
6. Cropping intentions for next four years, expected yields, and tillage system (plow, chisel, disk, no-till, etc.):

| | Intended crop | Expected yield | Tillage system |
|---|---|---|---|
| This year | Soybeans | 50 | Chisel in fall |
| Next year | Corn | 140 | Fallplow |
| Third year | Soybeans | 50 | Disk |
| Fourth year | Wheat | 40 | |

7. How deep do you plow? 7"-9"
8. Are there any special problems? An old barnyard is located in the northwest corner of the field.

The north 10 acres has received manure applications the last two years. A pond is located in the southeast corner of the field.

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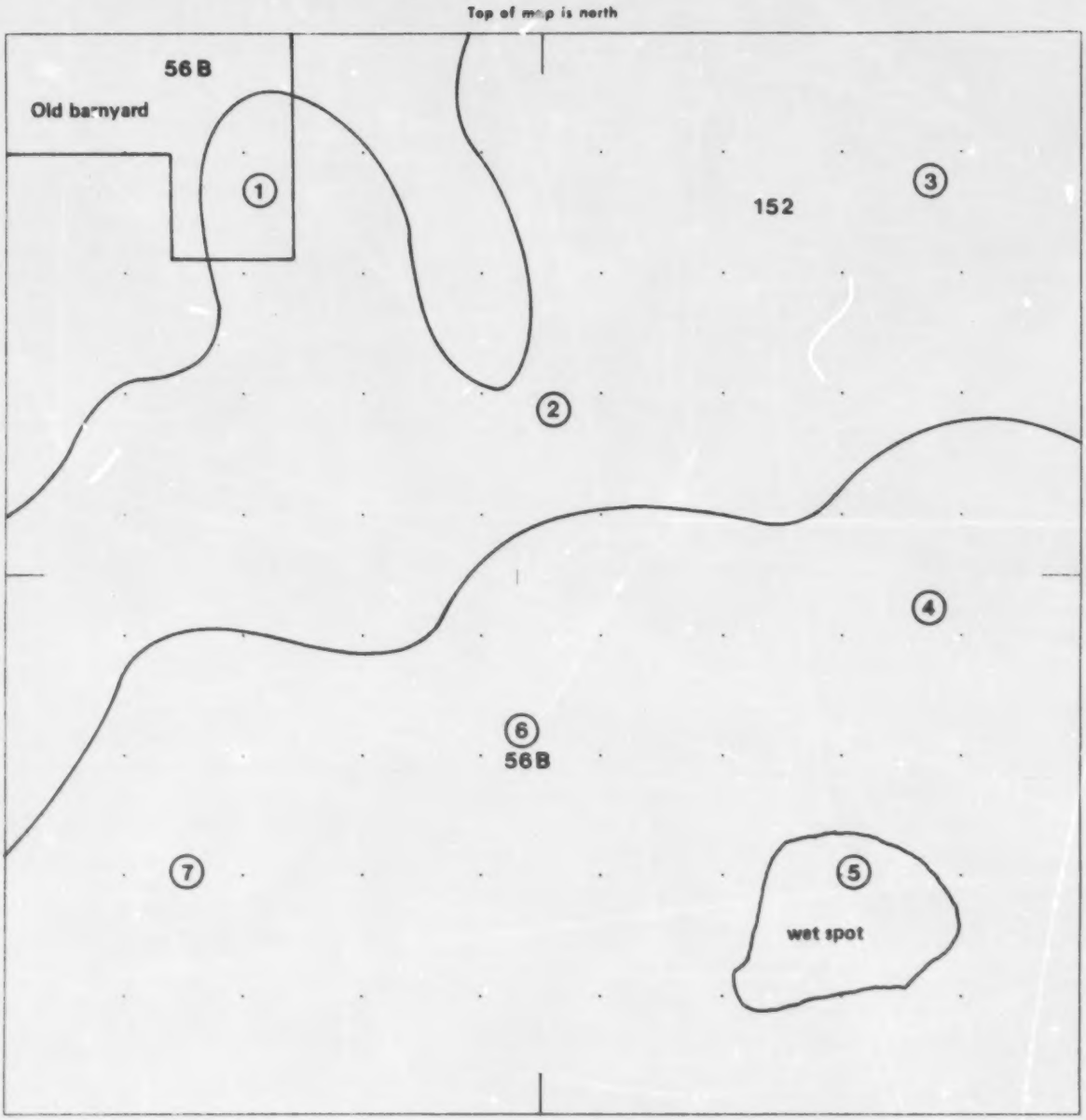
I-F-2-43

56B = Dana
152 = Drummer
20 acre field

## MAP OF THIS FIELD

(Number the sample locations)

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Soil Test Form D-1

# SOIL TEST REPORT

Blueboy County

Samples brought in by Tom Test

Date: _____ (received) _____ (tested)

Samples tested by A. Adams

Tenant: Tom Test Address: Testville, IL

Owner: Same Address: Same

This report gives you the results of the laboratory tests on your samples.

I suggest that you *keep this report in a permanent folder. Record right on the field maps* the amounts of lime and fertilizer that you apply and the dates when you apply them. This record will help you to interpret the next test on the field and will also give you a long-term inventory that will show whether soil fertility is being built up, is being maintained, or is declining.

| Field and sample number | Acres | pH Test for acidity | $P_1$ Test for available phosphorus | K Test for potassium | Organic matter or soil color | Comments |
|---|---|---|---|---|---|---|
| Field I | 20 | | | | | |
| Sample #1 | | 6.9 | 205 | 1250 | 5.8 | |
| 2 | | 7.0 | 18 | 275 | 4.8 | |
| 3 | | 6.8 | 24 | 315 | 4.5 | |
| 4 | | 5.8 | 15 | 130 | 4.2 | |
| 5 | | 5.7 | 140 | 310 | 5.0 | |
| 6 | | 6.1 | 20 | 145 | 4.7 | |
| 7 | | 6.0 | 17 | 137 | 4.5 | |

Soil tests are only a means to an end. The important thing is how you use the results to plan a better soil-fertility program. Planning the most profitable soil treatments after you have the results of the soil tests is not simple, but it is extremely important in determining your profit from farming.

On the back of this sheet, and on the other sheets labeled LIME, PHOSPHORUS, or POTASSIUM, you will find the information that you need to understand the tests so that you can plan a more profitable soil-fertility system. If you have further questions, please contact me.

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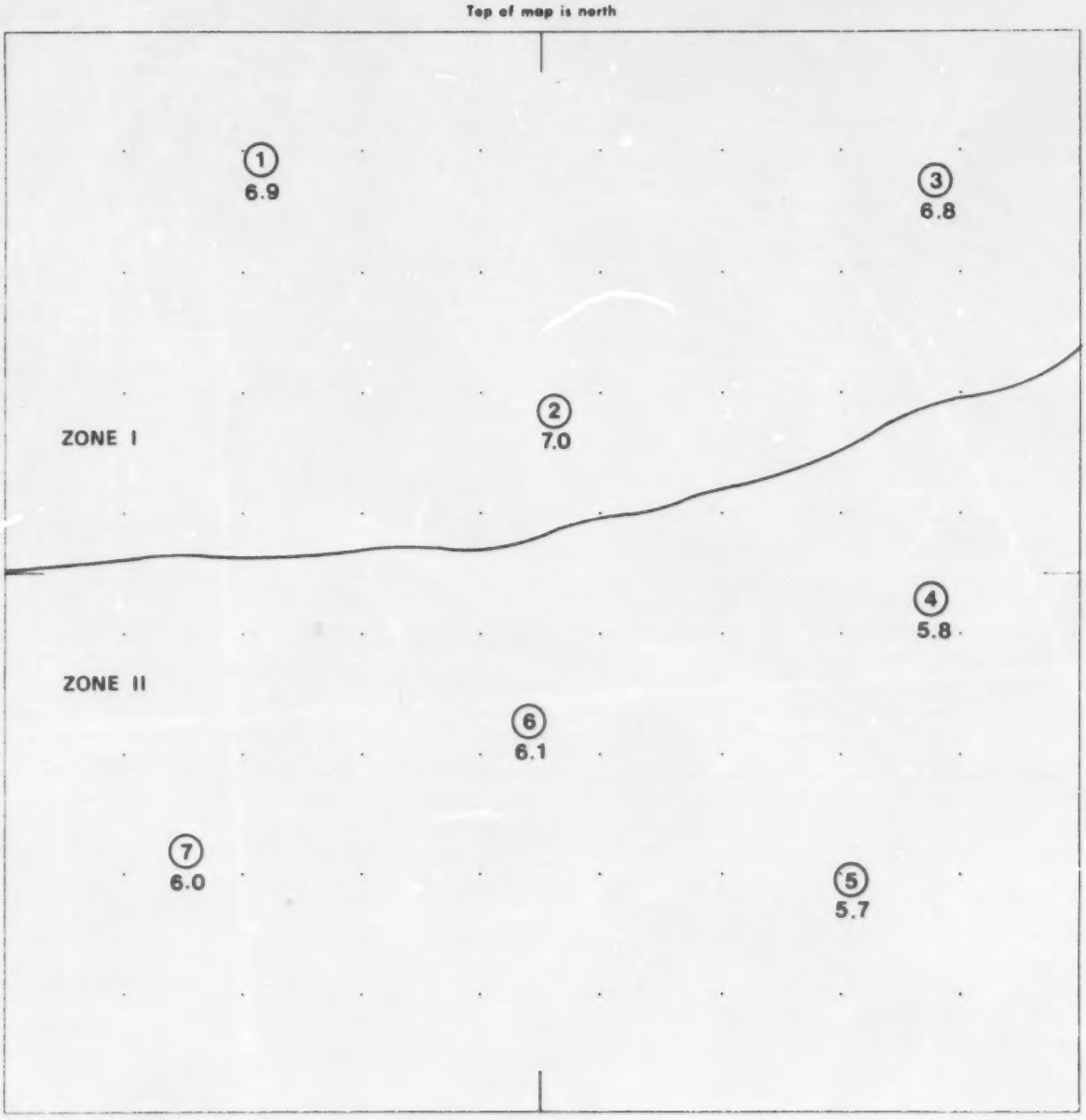
## MAP OF THIS FIELD

(Number the sample locations)

pH Results

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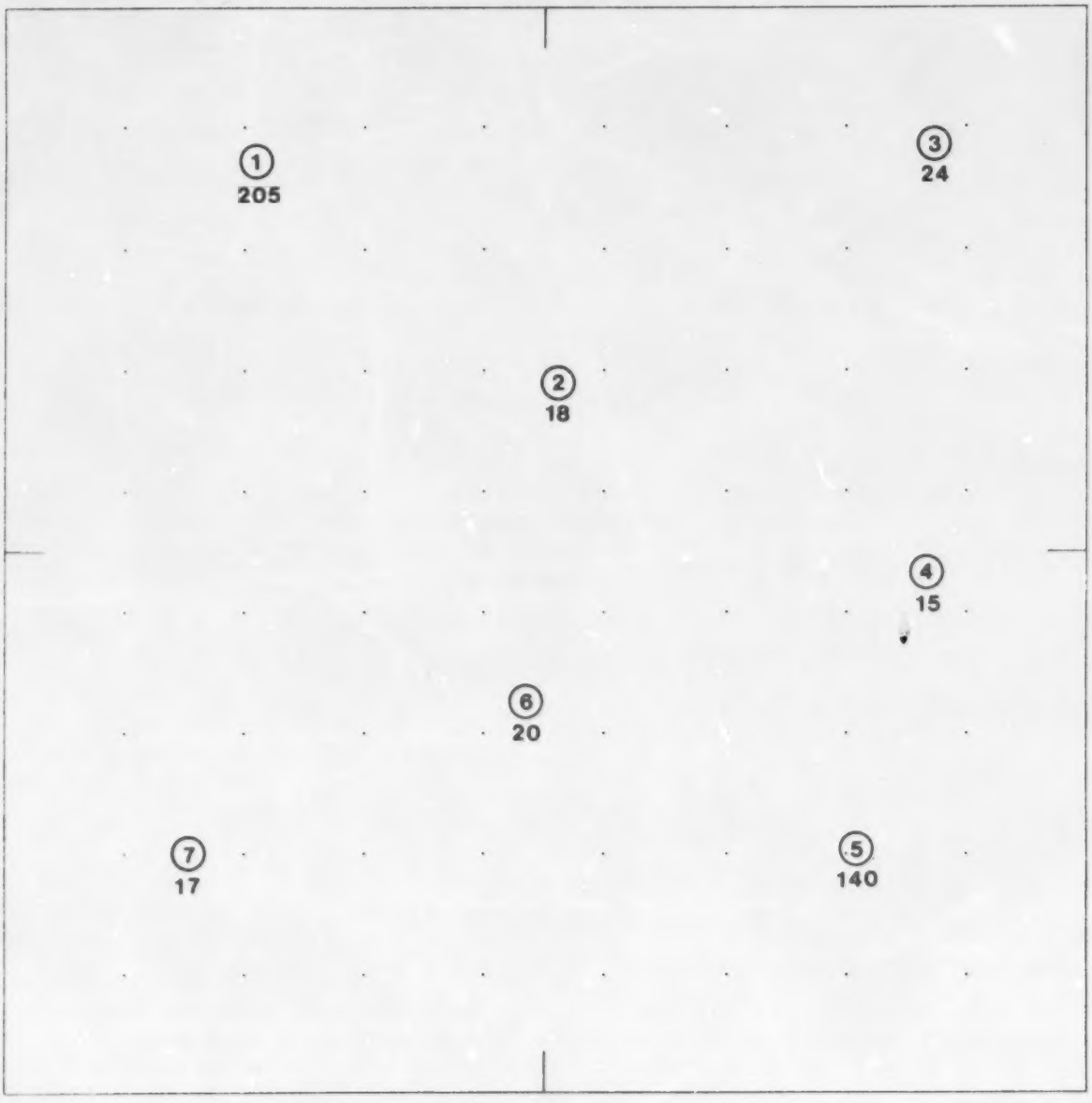
## MAP OF THIS FIELD
(Number the sample locations)

### $P_1$ Results

Top of map is north




south

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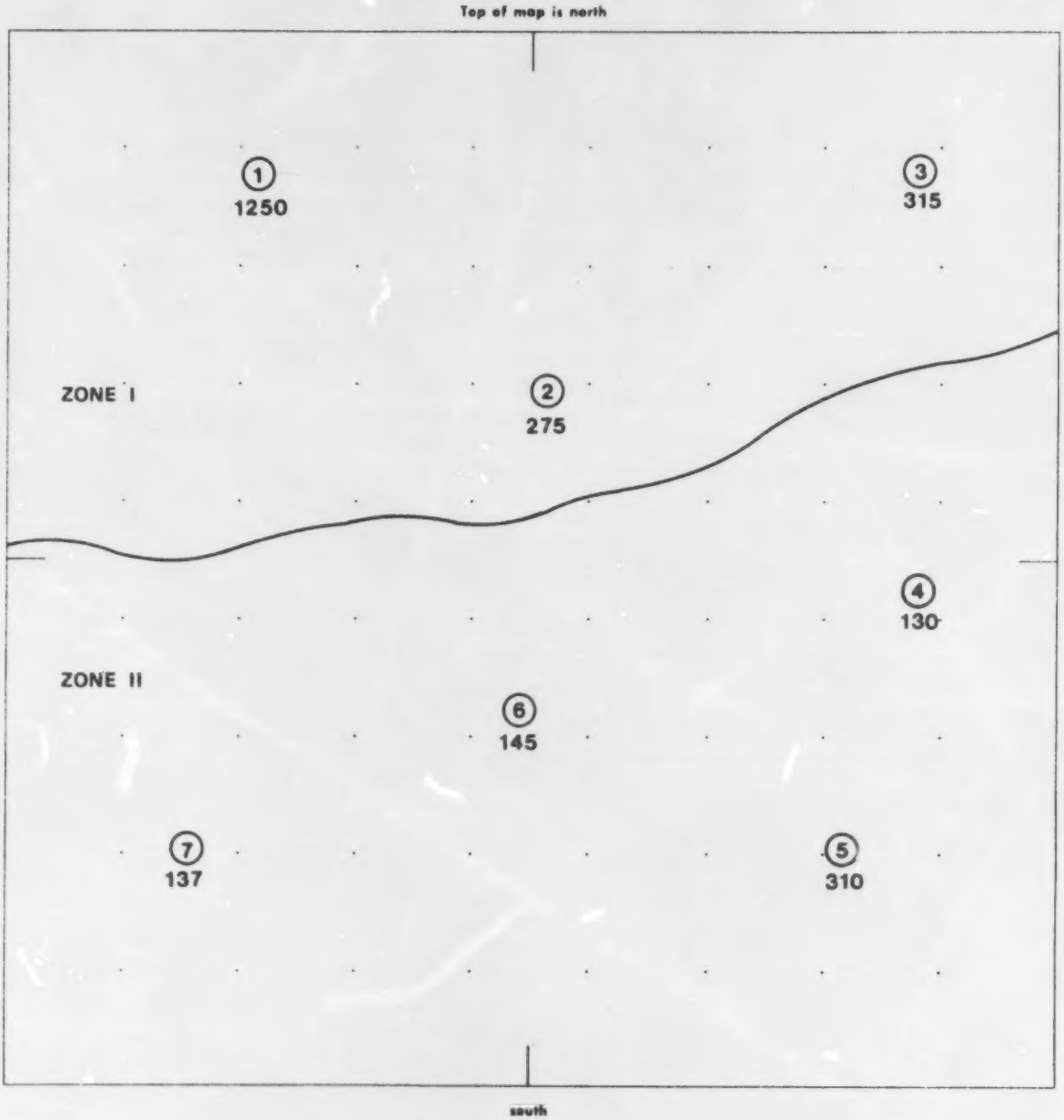
## MAP OF THIS FIELD

(Number the sample locations)

K Results

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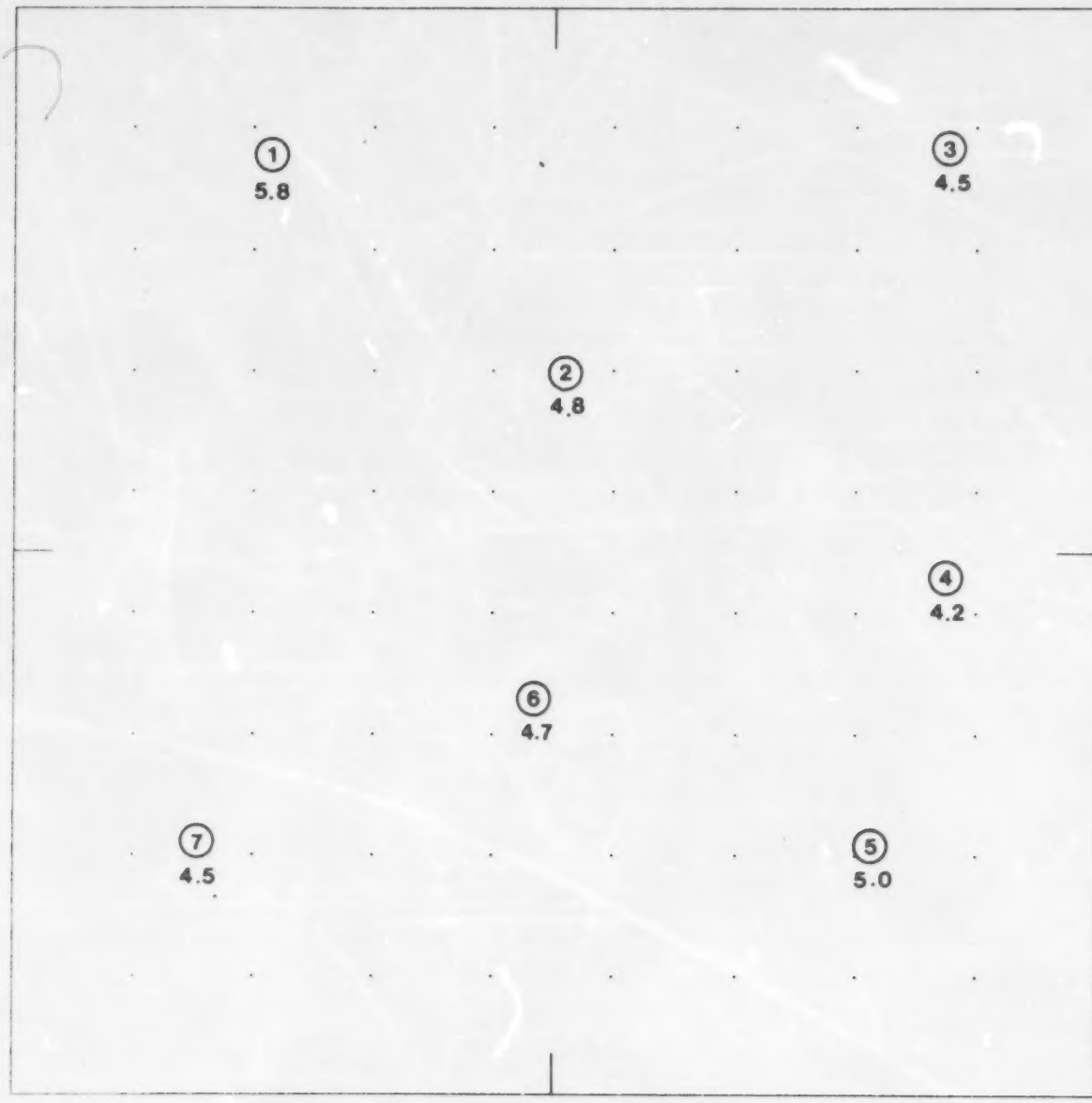
## MAP OF THIS FIELD

**(Number the sample locations)**

**Organic Matter Results**

Top of map is north




south

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434 Mumford Hall
Urbana, Ill. 61801

UNIT G: Horticulture

PROBLEM AREAS:

1. Growing vegetables
2. Beautifying the homestead

## UNIT G: HORTICULTURE

## PROBLEM AREA: GROWING VEGETABLES

### SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with ninth grade or beginning students enrolled in an agricultural horticultural occupations program. The recommended time for teaching this problem area is late winter. The estimated time for teaching this problem area is 5 to 10 days depending on how much time the teacher wishes to spend on discussion and conducting the suggested exercises. The materials in this problem area were selected and written with the following assumptions:

1. Each student will have the opportunity to develop a S.O.E. program in vegetable gardening.
2. Where appropriate, school gardens or community gardens will be encouraged.
3. The Cooperative Extension Service, Park Districts, and Community College Agriculture Programs will be contacted for local gardening programs.

The instructor is encouraged to conduct a local search to locate other supplementary materials. The items in this problem area are for reference or modification as the teacher adapts these materials to his/her local situation.

### CREDIT SOURCES:

These materials were developed through a funding agreement, R-33-21-D-0542-388 with the Illinois State Board of Education, Department of Adult, Vocational and Technical Education Research and Development Section, 100 North First Street, Springfield, Illinois 62777. Opinions expressed in these materials do not reflect, nor should they be construed as policy or opinion of the State Board of Education or its staff.

The teacher's guide, worksheets, information sheet and test questions were developed by Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Rural Core Curriculum Pilot Test Teachers.

## TEACHER'S GUIDE

I. Unit: Horticulture

II. Problem area: Growing vegetables

III. Objectives: At the close of this problem area, students will:

1. Understand the steps in planning a vegetable garden.
2. Know how to select and prepare a garden site.
3. Be familiar with the major vegetables grown in Illinois.
4. Know the factors to consider when selecting vegetable varieties and seed.
5. Know how and when to start seeds or transplants in a garden.
6. Know how to care for a vegetable garden.

IV. Suggested interest approaches:

1. Ask the class the following lead question: Did any of you have a vegetable g year? What types of vegetables did you grow?
2. Ask the class to identify advantages of vegetable gardening at home.
3. Present figures to show the importance of gardening and the increased interest p have in gardening.
(A 1980 estimate for vegetables grown in a 25' x 30' garden was more than $50
4. Ask the class to identify the best gardener they know and have them describe th person's gardening program.
5. Ask the class to respond to the following questions:
   a. How many of you would like to start a garden project?
   b. How many of you would be interested in exhibiting vegetables at a fair?
   c. How many of you would like to earn money from gardening?
6. Ask the students why tomatoes are considered fruit and why carrots, roots an petioles.

V. Anticipated problems and concerns of students:

<u>Planning the garden</u>

1. Why is it helpful to lay the garden out on paper?
2. At what time of the year should I begin to plant my garden?
3. How can trees and shrubs near the garden affect vegetable growth?

4. Do all vegetables require full sunlight?

5. What are the major vegetables grown in Illinois?

6. What are the different plant structures that are eaten?

7. What is a variety?

8. What is meant by the term "hybrid"?

9. What does "germination rate" mean?

10. What is the meaning of disease resistance?

11. Why is spacing between the rows important?

Preparing the garden

12. What is meant when referring to "good" soil?

13. Where can one have soil tested?

14. How can soil tilth be improved?

15. How can I tell if the soil is too wet to work?

Planting the garden

16. What are the reasons for using transplants?

17. Can vegetable seed be saved and used the following year?

18. How do freeze dates relate to the planting of vegetables?

19. What benefits do transplants have over seed grown vegetables?

Caring for the garden

20. Why are chemical herbicides seldom used in vegetable gardening?

21. In what ways do weeds compete with vegetables?

22. How often does a vegetable garden need to be watered?

23. Can I use the same insecticides used on farm crops in the vegetable garden?

24. Will my vegetables be harmed if I use black walnut leaves for a mulch?

VI. Suggested learning activities and experiences:

1. Discuss the advantages of having a home vegetable garden.

2. Discuss why it helps to plan the vegetable garden in advance.

3. Introduce the students to terms commonly used when speaking about vegetable
Have them complete Student Worksheet 1 on matching common terms.

4. Discuss the important factors in selecting a growing site for vegetables.

5. Give an out-of-class exercise. Have the students make a sketch of their home property, indicating the approximate locations of buildings, trees, fences, etc. Then, ask them to select two sites they feel are suitable to locate a garden.

6. Discuss the improvement of soil tilth, soil testing, fertilization, and the preparation of soil in the garden.

7. Have students collect soil in the school yard and prepare it for a soil test. Have the soil tested, then discuss any treatment that would be needed to make it suita for a vegetable garden.

8. Identify the major vegetables grown in Illinois and discuss their edible parts.

9. Have the students complete Student Worksheet 2 on garden vegetables. Use **Gardening for Illinois** as a reference.

10. Provide a list of major vegetables. Include figures on recommended spacing betv rows and inches between plants after thinning or transplanting. Refer to Page 2 **Vegetable Gardening for Illinois** for information.

11. Explain the selection of vegetable varieties.

12. Discuss what is important to look for when selecting seed or transplants.

13. Have the students order tomato seeds from a catalog. Plant the seed in class, an each student take home some plants.

14. Have the students complete a worksheet on the labeling of seed packets.

15. Explain how to sow seed and transplant vegetables.

16. Discuss frost free days and freeze dates in Illinois.

17. Provide a handout on freeze dates, frost free days in Illinois, and planting dates vegetables in Illinois gardens. Information on these topics may be found on Pag 21 and 23 in **Vegetable Gardening for Illinois.**

18. Have the students plan a home vegetable garden out of class, using the Student W sheet 3 for sketching the vegetable garden. The assignment should include the selection of at least 12 different vegetables, spacing of the vegetables, and the pl date for each vegetable. An example garden plan may be found on Page 26 in **Vegetable Gardening for Illinois.**

19. Provide Student Worksheet 4 for planning a vegetable garden, and have the stud record information on 12 different vegetables. The information needed can be fo in **Vegetable Gardening for Illinois.**

20. Discuss the importance of weed control in the vegetable garden. Also, discuss th methods used to control weeds.

21. Discuss when and how to water a vegetable garden.

22. Discuss how to control disease and insect pests in a vegetable garden.

23. Discuss the types of hand and power tools used in vegetable gardens.

24. Distribute **Fruit or Vegetable Production Record Book** to students. Assign the **Problem For Use With Fruit or Vegetable Production Record Book.**

VII. Application procedures:

1. Skills learned in this problem area should be used for home gardening purposes.

2. The skills learned will be valuable for students who plan to work in garden centers.

VIII. Evaluation:

1. Collect and evaluate worksheets.

2. Evaluate students performance skill in planning and caring for a garden.

3. Administer and grade a test upon the completion of this problem area.

4. Evaluate students ability to keep and use the record book problem.

IX. References and aids:

| | | |
|---|---|---|
| 1. | **Vegetable Gardening for Illinois** | J. S. Vandemark and J. W. Courter<br>U. of I. Cooperative Extension Service<br>Circular 1150 |
| 2. | **Crocketts' Victory Garden** | James Underwood Crockett, 1977<br>WGBH Educational Foundation, Inc.<br>Published by Little, Brown & Co. |
| 3. | **Fruit or Vegetable Production Record Book** | Vocational Agriculture Service<br>434 Mumford Hall<br>Urbana, IL 61801 |
| 4. | **Problem for Use with Fruit or Vegetable Production Record Book** | Vocational Agriculture Service<br>434 Mumford Hall<br>Urbana, IL 61801 |

5. Supplementary materials found in this packet:

   a. Student Worksheet on Matching Common Terms
   b. Student Worksheet on Garden Vegetables
   c. Student Worksheet for Sketching the Vegetable Garden
   d. Student Worksheet for Planning a Vegetable Garden

## STUDENT WORKSHEET 1

## MATCHING COMMON TERMS

| | | |
|---|---|---|
| _____ 1. | Viable | A. The moving of a plant from one location to another. |
| _____ 2. | Cool Season Vegetable | B. Vegetables grown for their edible roots. |
| _____ 3. | Hybrid | C. Vegetable grown for their edible leaves. |
| _____ 4. | pH | D. Vegetables grown for their fruit. |
| _____ 5. | Rotation | E. Decomposing animal or plant matter. |
| _____ 6. | Organic Matter | F. Material used to supply one or more elements for plant growth. |
| _____ 7. | Transplanting | G. A mixture of decayed plant material. |
| _____ 8. | Germination | H. Those vegetables that perform better in cool weather. |
| _____ 9. | Pole-type | I. Those vegetables that perform better in warm weather. |
| _____ 10. | Hardy | J. Self supporting plant. |
| _____ 11. | Leaf Crop | K. Non-self supporting plant. |
| _____ 12. | Tilth | L. The practice of changing the locations of crops in the garden from year to year. |
| _____ 13. | Fruit Crop | M. The sprouting of seed. |
| _____ 14. | Compost | N. Plant produced from the cross between the different species. |
| _____ 15. | Seed | O. Ripened ovule containing plant embryro. |
| _____ 16. | Fertilizer | P. Seed which are live and capable of germination. |
| _____ 17. | Bush type | Q. Vegetable tolerant to light frosts and cool weather. |
| _____ 18. | Root Crop | R. Acidity or alkalinity of soil. |
| _____ 19. | Warm Season Vegetable | S. Ability of plants to withstand adverse conditions. |
| _____ 20. | Tolerant | T. Ability of soil to be broken down into fine crumbs. |

## STUDENT WORKSHEET 2

## GARDEN VEGETABLES

List 6 vegetables grown for their leaves or greens.

1. _____ 4. _____
2. _____ 5. _____
3. _____ 6. _____

List 6 types of vegetables usually transplanted to the garden.

1. _____ 4. _____
2. _____ 5. _____
3. _____ 6. _____

List 6 types of vegetables started in the garden as seed.

1. _____ 4. _____
2. _____ 5. _____
3. _____ 6. _____

List 6 vegetables grown for their fruit.

1. _____ 4. _____
2. _____ 5. _____
3. _____ 6. _____

List 6 vegetables grown for their underground structures (roots, tubers, bulbs).

1. _____ 4. _____
2. _____ 5. _____
3. _____ 6. _____

## STUDENT WORKSHEET 3

## SKETCHING THE VEGETABLE GARDEN

1. Select 12 different vegetables and locate them below as you would in your garden.
2. State the planting date and spacing requirements for each vegetable.

North

30'

25'

Scale: ¼" = 1'0"

## STUDENT WORKSHEET 4

## PLANNING A VEGETABLE GARDEN

I. **Introduction:**

The purpose of this exercise is to provide a means in which the student can efficiently plan a vegetable garden.

II. **Objective:**

At the conclusion of this exercise, students will have gathered and organized the vital information for planning a garden. From the plans developed, students will be able to plant a vegetable garden.

III. **Procedure:**

While referring to **Vegetable Gardening for Illinois,** record the following information for 12 vegetables: Name (including variety name), number of plants to be grown, the recommended distances between rows and plants (page 24), the length of the row, expected yields (page 3), dates of planting (page 23), type of planting (seed or transplant), and planting depth of seed (page 22).

Name _____ Period ____

## STUDENT WORKSHEET 4 – PLANNING A VEGETABLE GARDEN

| Name of Vegetable | Number of Plants | Distance between: Rows | Distance between: Plants | Length of Row | Expected Yield | Date of Planting | Type of Planting Seed/Transplant | Depth of Seed |
|---|---|---|---|---|---|---|---|---|
| Tomato 'Early Girl' | 4 | 3' | 2' | 8' | 53 lbs. | May 15 | Transplant | ------- |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

I-G-1-11

TEACHER'S KEY
STUDENT WORKSHEET 1

## MATCHING COMMON TERMS

| | | | |
|---|---|---|---|
| P | 1. | Viable | A. The moving of a plant from one location to another. |
| H | 2. | Cool Season Vegetable | B. Vegetables grown for their edible roots. |
| N | 3. | Hybrid | C. Vegetable grown for their edible leaves. |
| R | 4. | pH | D. Vegetables grown for their fruit. |
| L | 5. | Rotation | E. Decomposing animal or plant matter. |
| E | 6. | Organic Matter | F. Material used to supply one or more elements for plant growth. |
| A | 7. | Transplanting | G. A mixture of decayed plant material. |
| M | 8. | Germination | H. Those vegetables that perform better in cool weather. |
| K | 9. | Pole-type | I. Those vegetables that perform better in warm weather. |
| Q | 10. | Hardy | J. Self supporting plant. |
| C | 11. | Leaf Crop | K. Non-self supporting plant. |
| T | 12. | Tilth | L. The practice of changing the locations of crops in the garden from year to year. |
| D | 13. | Fruit Crop | M. The sprouting of seed. |
| G | 14. | Compost | N. Plant produced from the cross between the different species. |
| O | 15. | Seed | O. Ripened ovule containing plant embryro. |
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| J | 17. | Bush type | Q. Vegetable tolerant to light frosts and cool weather. |
| B | 18. | Root Crop | R. Acidity or alkalinity of soil. |
| I | 19. | Warm Season Vegetable | S. Ability of plants to withstand adverse conditions. |
| S | 20. | Tolerant | T. Ability of soil to be broken down into fine crumbs. |

TEACHER'S KEY
STUDENT WORKSHEET 2

# GARDEN VEGETABLES

List 6 vegetables grown for their leaves or greens.

1. Broccoli
2. Cabbage
3. Lettuce
4. Spinach
5. Parsley
6. Rhubarb

List 6 types of vegetables usually transplanted to the garden.

1. Broccoli
2. Brussel Sprouts
3. Cauliflower
4. Tomato
5. Pepper
6. Rhubarb

List 6 types of vegetables started in the garden as seed.

1. Beans
2. Carrots
3. Sweet Corn
4. Cucumber
5. Lettuce
6. Radish

List 6 vegetables grown for their fruit.

1. Beans
2. Pepper
3. Sweet Corn
4. Cucumber
5. Tomato
6. Pumpkin

List 6 vegetables grown for their underground structures (roots, tubers, bulbs).

1. Beet
2. Carrot
3. Onion
4. Potato
5. Turnip
6. Parsnip

## TEACHER'S KEY

## SAMPLE TEST QUESTIONS ON VEGETABLE GARDENING

### Completion Section

1. A plant that can withstand light frosts and cool temperatures is considered hardy.
2. Young plants which are crowded should be thinned to allow plenty of room for growth.
3. Moving a plant from one location to another is called transplanting.
4. Organic matter may be added to soil to improve tilth.
5. Dead leaves, food scraps and grass clippings can be placed on a compost pile to decay.
6. Soil tests tell you the pH of the soil and content of nitrogen, % organic matter, phosphorus and potassium.
7. When watering the vegetable garden it is a good practice to soak the soil to the depth of 6 - 8 inches.
8. Leaves that remain wet for extended periods of time may be susceptible to disease.
9. During the drought periods watering may be necessary every 7 - 10 days.
10. Morning is the best time of the day to water a garden.

### Listing Section

1. List 4 factors to consider when selecting a vegetable garden site.
   1. Soil
   2. Sunlight
   3. Away from obstructions
   4. Close to home
2. List 3 types of mulches
   1. Wood chips
   2. Grass clippings
   3. Straw
   4. Peat moss
   5. Black plastic

## TRUE–FALSE SECTION

F 1. Use of herbicides is the most common method of weed control in the vegetable garden.

F 2. All vegetables must be planted after the average frost free date in your area.

T 3. Transplants will recover from transplant shock more quickly if planted on a cloudy day or in the evening.

T 4. The quality of the soil will affect the quality of your vegetables.

F 5. All vegetables do equally well in full sun or deep shade.

T 6. Vegetable gardening is rising in popularity partly because of high food costs.

T 7. Proper spacing of vegetables reduces competition for light, water and nutrients.

T 8. Planning a garden on paper helps eliminate the chance of underplanting or overplanting.

T 9. Different vegetable seeds have different germination requirements.

F 10. Soil tilth can only be improved by roto-tilling.

T 11. The three major nutrients used by plants are nitrogen, phosphorus, and potassium.

F 12. It is a good practice to water your garden for about five minutes every day.

T 13. Some vegetable varieties are more desirable than others.

T 14. Soil tests and the gardener in determining how much, if any, fertilizer, organic matter, lime or acidifying material should be added.

F 15. It is best to work soil after a heavy rain.

## UNIT G: HORTICULTURE

## PROBLEM AREA: BEAUTIFYING THE HOMESTEAD

### SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with ninth grade or beginning students enrolled agricultural occupations program. The recommened time for teaching this problem area is spring semester. The estimated time for teaching this problem area is 5 to 10 days depend how much time the teacher wishes to spend on discussion and conducting the suggested exe The materials in this problem area were selected and written with the following assump

1. Each student will have the opportunity to develop a S.O.E. project using the landscape.

3. Students have little or no background in planting and caring for trees, shrubs an grass.

The instructor is encouraged to conduct a local search to locate other supplementary materials. The items in this problem area are for reference or modification as the teacher adapts materials to his/her local situation.

### CREDIT SOURCES:

These materials were developed through a funding agreement, R-33-21-D-0542-388 wi Illinois State Board of Education, Department of Adult, Vocational and Technical Educ Research and Development Section, 100 North First Street, Springfield, Illinois 62777. Op expressed in these materials do not reflect, nor should they be construed as policy or opin the State Board of Education or its staff.

The teacher's guide, worksheets, information sheet and test questions were develop Ron Biondo, Department of Vocational and Technical Education, University of Illinois. Sugge and guidance in the development of these materials were provided by the Rural Core Curr Pilot Test Teachers.

## TEACHER'S GUIDE

I. Unit: Horticulture

II. Problem area: Beautifying the homestead

III. Objectives: At the close of this problem area students will:

1. Know how to care for an established lawn.
2. Know the correct methods of pruning the various types of trees and shrubs.
3. Be qualified to plant balled and burlapped trees and shrubs correctly.

IV. Suggested interest approaches:

1. Ask the students to identify the best kept lawn and landscape in town.
2. Ask the students if their own landscape could look better. If so, how?
3. Present a question: "What makes a home landscape attractive?"
4. Ask how many students would be interested in a career in landscaping. List occupations that students may consider and qualifications for each.
5. Ask the students to identify professional landscapers in the area. What are some of their practices?
6. Have a professional landscape contractor or golf course manager appear as a guest speaker.

V. Anticipated problems and concerns of students:

1. What are the differences between organic and inorganic fertilizer?
2. How often should a lawn be fertilized?
3. How much fertilizer should be used?
4. Why shouldn't you fertilize the lawn in August?
5. How often should a lawn be watered?
6. How can you measure the amount of water applied to a lawn?
7. Is it better to catch grass clippings or let them lie on the lawn?
8. Can insect, weed and disease problems be handled without using chemicals?
9. How can turf be grown in shady situations?
10. At what height should I mow my lawn?

11. What is top dressing, overseeding, and power raking?

12. Why is pruning necessary?

13. Does pruning paint protect the tree injury from disease or insects?

14. When is the best time to prune?

15. What is renewal pruning?

16. Why should hedges be wider at the base?

17. What is rejuvenation pruning?

18. Why is a cut flush with the trunk so important?

19. Why is it inadvisable to remove more than a third of the tree's crown at any on

20. Do all trees and shrubs sold for planting come with balled and burlapped roots?

VI. Suggested learning activities and experiences:

1. Discuss the differences between organic and inorganic fertilizers. What are the advantages of each?

2. Discuss the best times to fertilize a lawn and how fertilizing can be done. Touc the reasons for fertilizing. Have the class fertilize a section of grass on the scho grounds using various types of fertilizer spreaders.

3. Explain the factors that should be taken into account when watering a lawn. U coffee cans, demonstrate how the amount of water applied can be measured.

4. Discuss the importance of timely mowings, mowing to the correct height, and s of mower blades.

5. Discuss the different methods of weed control in the lawn.

6. Emphasize the fact that weeds, disease, and insect problems can be reduced by maintenance or cultural practices.

7. Discuss how one might go about growing grass in a shaded area.

8. Bring a 6" x 6" x 6" section of turf to class. Discuss the soil relationship, the t layer and the plant structures.

9. Bring various pruning equipment to class and discuss the use of each.

10. Present the major reasons for pruning trees and shrubs.

11. Discuss the best time of the year to prune most trees. Also, discuss the pruning flowering shrubs.

12. Describe the drop crotch or 3 cut method of removing large limbs from trees.

13. Discuss the correct way to prune or shear hedges.

14. Discuss renewal pruning and rejuvenation pruning of shrubs.

15. Explain how to prune pines and evergreens with scale-like foliage.

16. Take a walk with the class. Point out trees or shrubs in need of pruning. Discuss the methods of pruning in different situations.

17. Have the students complete Student Worksheet 1 on pruning.

18. Ask school officials for permission to prune a tree or shrubs on school grounds. Then let students do some pruning. Have them explain why they think certain cuts should be made before making them.

19. Discuss the factors to consider when selecting a planting location for trees or shrubs.

20. Discuss the minimum dimensions for holes in which trees or shrubs will be placed.

21. Discuss how poor soil may be improved and used as backfill.

22. Discuss the level at which a root ball should be placed in a hole and the backfill procedures.

23. Explain post planting care such as watering, pruning, bracing and using tree wrap.

24. Have the students complete Student Worksheet 2 on transplanting trees and shrubs.

25. Plan a tree planting on Arbor Day (last Friday in April) involving the class. Seek help from the city or park district and make it a community project. Have the class carry out the entire planting procedure.

26. Distribute **Home and Farmstead Beautification Record Book** and encourage students to keep records of their beautification activities.

VII. Application procedures:

1. The skills learned in this problem area should be used in caring for the home landscape.

2. The skills learned will be useful for students seeking careers in landscaping, golf course maintenance, and garden center management.

VIII. Evaluation:

1. Collect and grade worksheets.

2. Evaluate students ability to prune and/or transplant trees and shrubs.

3. Administer and grade a written test upon the completion of this problem area.

4. Evaluate students record book on **Home and Farmstead Beautification.**

IX. References and aids:

1. Available from Vocational Agriculture Service, 434 Mumford Hall, 1301 W. Gregory, Drive, Urbana, IL 61801

   **Slidefilms**

   a. 615 Objectives of Pruning Deciduous Trees
   b. 643 Pruning Evergreens
   c. 644 Pruning Deciduous Shrubs
   d. 651 Steps to a Better Lawn
   e. 641.3 Proper Transplanting of Trees

   **Record Books**

   a. Home and Farmstead Beautification

   **Subject-Matter Units**

   a. 5002 Transplanting Shade Trees

2. Available at the University of Illinois, College of Agriculture, Cooperative Extension Service.

   a. Circular 1082, Illinois Lawn Care and Establishment
   b. Circular 1033, Pruning Evergreens and Deciduous Trees and Shrubs

3. Supplementary materials found in this packet:

   a. Information sheet: Transplanting Balled and Burlapped Trees
   b. Student Worksheet on Pruning
   c. Student Worksheet on Transplanting Trees and Shrubs

## INFORMATION SHEET

## TRANSPLANTING BALLED AND BURLAPPED TREES

LOCATION: Before planting a tree, give careful consideration to where it will be located. Avoid areas that are known to collect water. Also, trees will find difficulty growing in soils that are extremely hard.

Trees should be planted far enough from buildings and other obstacles to allow for adequate sunshine, ran, air circulation and room for normal growth.

DIGGING THE HOLE: Dig a hole much larger than the tree ball. Allow for a minimum of 6 inches open space around the entire ball. Dig the hole at least 6 inches deeper than the height of the ball.

IMPROVING SOIL TEXTURE: Heavy clay soils common in parts of Illinois often need soil amendments. Thoroughly mix peat moss, compost or similar materials into the soil to be used for backfilling. The addition of organic materials will insure adequate aeration, water retention and good root growth.

PLACING THE PLANT: Place enough soil at the bottom of the hole so the tree can be planted at the same depth as it was before it was dug.

Nylon twine and green burlap resist decay and will strangle the tree roots and possibly kill the tree. To avoid this, remove them before backfilling and throw away.

Brown burlap will rot, so it may be left on. However, peel it back over the ball. Any burlap sticking above the ground will serve as a wick and draw water from the tree ball.

FILLING THE HOLE: Once the tree is properly positioned, backfill the hole halfway. Step this soil down to eliminate air pockets. Then, fill the hole to the top with water. Allow the water to be absorbed before completing the backfill process. Do not step down wet soil. Leave a soil lip circling the hole to form a basin for holding water. A two inch layer of mulch on top of the ball will help to retain moisture.

PRUNING: Newly planted trees should be pruned to compensate for the loss of roots when the tree was dug. Select branches to be removed carefully so as not to lose the natural growth habit of the tree. Make all cuts flush to the adjoining limb. DO NOT remove more than 30% of the existing crown.

WRAPPING: Protect the trunk of newly planted trees from sunscald and frost cracks by using tree wrap or burlap. Tightly wrap the material around the trunk and secure it with twine.

BRACING: Newly planted trees should be braced from movement to protect the tiny roots just developing. Use a minimum of two stakes for trees up to 3" in diameter. Drive the stakes outside the hole you have dug. This will provide more secure footing. Attach the tree to the stakes with a wire run thrcugh a piece of hose to avoid injury to the tree trunk. Trees with diameters larger than 3" will need three stakes.

WATERING: Recently planted trees need an abundance of water. Supply enough water to soak the soil around the roots at each water. During prolonged dry periods it may be necessary to soak the soil every 10 days.

## STUDENT WORKSHEET 1

## PRUNING

1. Draw a diagram of the drop crotch or 3 cut method of pruning large limbs.

2. Sketch an end view of a properly sheared hedge and an improperly sheared hedge.

3. State when each of the following pieces of equipment should be used in pruning.

   hand pruners:

   chain saw:

   loppers:

   pole saw:

   hedge shears:

## STUDENT WORKSHEET 2

## TRANSPLANTING TREES AND SHRUBS

1. Sketch a newly transplanted tree and label the important factors to consider when transplanting.

2. Sketch a newly planted shrub.

## TEACHER'S KEY

## SAMPLE TEST QUESTIONS ON BEAUTIFYING YOUR HOME LANDSCAPE

**Multiple Choice**

d 1. The best time to fertilize a lawn is _____.

a. Spring
b. Summer
c. Fall
d. A and C

c 2. About _____ lbs. of nitrogen should be applied each year to 1000 sq. ft. of lawn.

a. 50–100
b. 1
c. 3–5
d. 7–9

b 3. It's beneficial to make _____ fertilizer applications a year to the lawn.

a. 12
b. 3–4
c. 1

a 4. Watering of a lawn should be done.

a. Every 2 weeks during drought periods
b. When community water supply is high
c. When the grass turns brown

d 5. Cool season grasses such as Kentucky Bluegrass should be mowed to about _____ inches in height.

a. 1
b. 4–5
c. 3
d. 2

d 6. Weed control is

a. Possible with herbicides
b. Often frustrating
c. Possible with good lawn maintenance practices
d. All of the above

d 7. Pruning is done to

a. Control plant growth
b. Develop strong framework
c. Remove undesirable parts
d. All of the above

c 8. Which is **not** a method of pruning?

a. Renewal
b. Rejuvenation
c. Retention
d. Drop crotch

c 9. Which factor is **not** an important consideration when locating a site for a tree?

a. Soil
b. Drainage
c. Burning ability
d. Room to grow

d 10. Tree wrap

a. Eliminates sprouts along the trunk
b. Reduces damage from sun scald
c. Protects the thin bark from rodents
d. All of the above

**True–False**

F 1. The best time to fertilize a lawn in Illinois is August.

T 2. To maintain a healthy lawn it is necessary to water deeply every two weeks during periods of drought.

T 3. Dull lawn mower blades may lead to disease problems in the lawn.

T 4. Use of herbicides is often necessary to control weeds in the lawn.

T 5. Newly planted trees or shrubs are often pruned to maintain a balanced root–to–shoot ratio.

F 6. Deciduous trees such as the sugar maple must be pruned in the spring when the sap is flowing.

T 7. Renewal pruning is a method of pruning shrubs by removing large, old and dead canes. Younger canes are left intact.

T 8. Rejuvenation pruning involves the removal of all existing canes, leaving 4–6" canes.

F 9. The hole for a balled and burlapped tree should be about the same size as the root ball.

F 10. Green burlap, pots, nylon twine and wire may all be planted with the tree because they will decay before tree roots are big enough to damage.

F 11. Always place several inches of soil over the root ball to insulate the roots from the cold.

T 12. Bracing of newly planted trees is necessary to provide stability and reduce the damage to developing roots.

**Matching**

| | | | |
|---|---|---|---|
| I | Mulch | A. | Considered to be a strong crotch |
| E | Thatch | B. | Chemicals used for weed control purposes |
| F | V–Crotch | C. | Sprouts, usually at the base of trees or shrubs |
| A | U–Crotch | D. | Low-growing multi-stem woody plant |
| H | Flush cut | E. | A tightly intermingled layer of living and dead stems, roots and leaves located between the soil surface and the green vegetation |
| G | Tree | | |
| D | Shrub | F. | Considered to be a weak crotch |
| C | Suckers | G. | Tall, usually single stemmed woody plant |
| J | Fertilizer | H. | Pruning cut that leaves no stub |
| B | Herbicides | I. | Straw, wood chips and peat are good examples |
| | | J. | Materials used to provide plants with elements |

UNIT H: Agricultural Mechanics

PROBLEM AREAS:

1. Identifying, fitting and using hand tools
2. Using selected power tools
3. Developing safe work habits in agricultural mechanics
4. Developing basic carpentry skills

## UNIT H: AGRICULTURAL MECHANICS

## PROBLEM AREA: IDENTIFYING, FITTING AND USING HAND TOOLS

### SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with freshman or beginning students enrolled in an agricultural/horticultural occupations program. The recommended time for teaching this problem area is during the early winter. The estimated time for teaching this problem area is 3 to 5 days depending on how much time the teacher wishes to spend on discussion and conducting the suggested exercises. The materials in this problem area were selected and written with the following assumptions:

1. It is important for all agriculture students to be able to identify common hand tools.

2. It is important for students to receive instruction in the proper use and care of hand tools.

The materials included in this problem area include both urban and rural materials. The teacher should adapt this material to his/her local situation.

### CREDIT SOURCES:

These materials were developed through a funding agreement, R-33-21-D-1542-388 with the Illinois State Board of Education, Department of Adult, Vocational and Technical Education, Research and Development Section, 100 North First Street, Springfield, Illinois 62777. Opinions expressed in these materials do not reflect, nor should they be construed as policy or opinion of the State Board of Education or its staff.

The teacher's guide, worksheets, transparency discussion guides were developed by Paul Benson, Jerry Pepple, and Jim Ethridge, Department of Vocational and Technical Education, University of Illinois. The transparency masters and suggested test questions were prepared by Vocational Agriculture Service, University of Illinois. The student worksheet on "Sharpening a Knife" was adapted from the Horticultural task sheet "Sharpening a Knife" developed by the Department of Agricultural Education, The Pennsylvania State University, University Park, PA 16802.

Suggestions and guidance in the development of these materials were provided by the pilot test teachers who worked with the Rural and the Urban Core Programs.

## TEACHER'S GUIDE

I. Unit: Agricultural mechanics

II. Problem area: Identifying, fitting and using hand tools

III. Objectives: At the close of the problem area students will:

1. Be able to identify commonly used hand tools.
2. Be able to sharpen or fit commonly used hand tools.
3. Be able to use hand tools in a proper and safe manner.

IV. Suggested interest approaches:

1. Have various hand tools displayed on a table and ask students to identify the tools by name and use.
2. Lead into a discussion of hand tools by asking students what hand tools they have at home.
3. Ask the student to name safe practices and procedures to follow in using certain hand tools.
4. Ask the students if they have been involved in any accidents when using hand tools.
5. Ask the students if they know the approximate cost of each tool and then have them figure a total value for their own tools.
6. Hand out hand tool puzzle sheet "I Tool You So" and challenge students to provide the answers.

V. Anticipated problems and concerns of students:

1. Why do I need to know the names of hand tools?
2. Why do I need to be able to sharpen hand tools?
3. Why do I need to wear safety glasses when using hand tools?
4. How do you sharpen certain hand tools?
5. How do I hold a board when sawing with a hand saw?
6. Why do I need to be able to recognize hand tools?
7. What hand tools are sharpened? How often?
8. How are various hand tools used?

VI. Suggested learning activities and experiences:

1. Discuss problems and concerns identified by class or teacher when first starting problem area.

2. Take students into the shop area and identify available hand tools. Use Job Sheet 1 and Student Worksheet 2.

3. Discuss the safety considerations of each group of tools identified. Use Worksheet 6.

4. Visit a local machinery dealership and identify hand tools there.

5. Distribute Worksheet 1, **Tool Identification**, and have class identify tools.

6. Show transparencies. Identify various parts of each tool and explain the correct procedures for their use.

   a. Hand Saws
   b. Types of Hand Planes
   c. Parts of the Brace and Bit
   d. Selecting Nail Hammers

7. Have each student demonstrate the proper use of one tool in the shop. For example, for the hand saw and square, provide each student with a board and have them saw one end so it will be square.

8. Have class read VAS Unit 3005, "Sharpening Hand Tools."

9. Distribute Worksheet 4, "Sharpening Hand Tools" and have class fill out.

10. Demonstrate the actual sharpening of certain hand tools in the shop. Use Job Sheet 2 and 3 and Student Worksheet 3.

11. Have each student bring in tools of each type to be sharpened.

12. Have students make 3 by 5 identificiation cards by cutting out pictures of tools from catalogs.

13. Schedule field trip for horticulture students to visit the ILCA (Illinois Landscape Contractors' Association) field day in August and/or the ILCA winter show to see jobbers display tools available.

VII. Evaluation:

1. Prepare and administer a pencil and paper test covering: identification of hand tools, proper use of hand tools, and sharpening of hand tools.

2. Grade worksheets.

3. Prepare and administer laboratory practical exam on identification, proper use, and sharpening of hand tools.

4. Administer VAS safety test "Safe Practices in the Vocational Agriculture Shop" (section on hand tools).

VIII. References and aids:

1. VAS Unit 3005, "Sharpening Hand Tools," Vocational Agriculture Service, University of Illinois.

2. VAS Safety Test, "Student Test on Hand Tools."

3. VAS Transparencies on Hand Tools.

4. Student Worksheets 1–5.

5. Phipps, Lloyd J., Mechanics in Agriculture, The Interstate Printers and Publishers, Danville, Illinois.

6. Hand tool puzzle sheet "I Tool You So."

7. VAS Slide Set No. 633, "Identifying and Using Horticultural Hand Tools." (Available in fall of 1981.)

8. Job Sheets 1, 2, and 3.

## HAND TOOL PUZZLE SHEET

### I TOOL YOU SO

Fill in each blank with the name of a tool used in a workshop.

_____ we _____ of you is that you _____ away at the job of having a good time. No other ad _____ is necessary. If you need a new idea, _____ the cobwebs off your brain and _____. You will _____ little _____. That's the _____. _____ up your courage. Don't be as dead as a door _____. Try a new _____. _____ your way through difficulties. If you do, it _____ well for your future. That's _____, isn't it? _____ up! Just tell them that you _____ me at the WORKSHOP PARTY.

THE TOOL CHEST HAS BEEN UPSET, AND WE MUST GET IT BACK IN ORDER. The following is a group of tools with the letters disarranged. Can you straighten them out?

_____ 1. Urel

_____ 2. Aws

_____ 3. Lnai ets

_____ 4. Memhar

_____ 5. Elrwot

_____ 6. Alnep

_____ 7. Careb

_____ 8. Law

_____ 9. Exa

_____ 10. Sive

_____ 11. Husbr

_____ 12. Cetthha

_____ 13. Leeend

_____ 14. Itb

_____ 15. Rcsew virder

_____ 16. Cenhrw

_____ 17. Rusqae

_____ 18. Life

_____ 19. Shicle

_____ 20. Chunp

_____ 21. Rescw

_____ 22. Lina

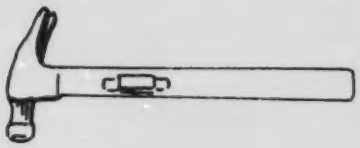
_____ 23. Catk

_____ 24. Finke

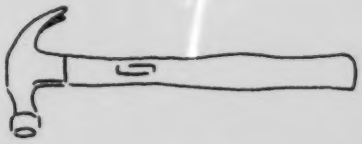
_____ 25. Guares

## TOOL IDENTIFICATION

Worksheet 1

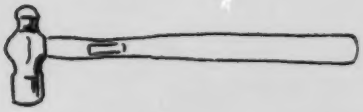


1. _____



2. _____

3. _____



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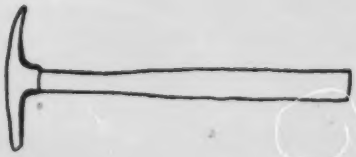
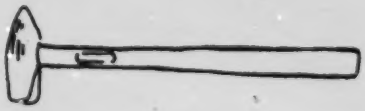


5. _____



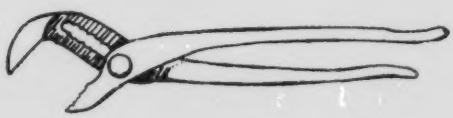
6. _____

7. _____

8. _____

## Worksheet 1, Page 2

9. _____

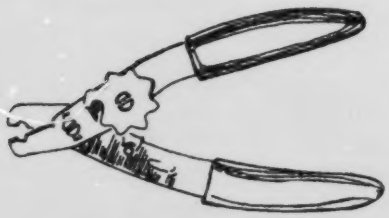


10. _____

11. _____

12. _____

13. _____



14. _____

15. _____

16. _____

17. _____

18. _____

19. _____

20. _____

21. _____

22. _____

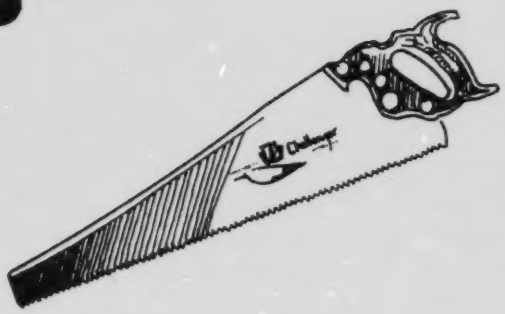
23. _____

24. _____

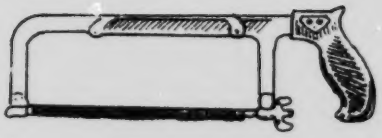
25. _____

26. _____

27. _____



28. _____



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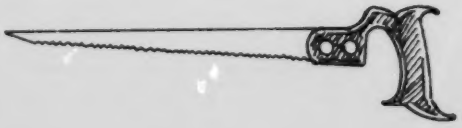
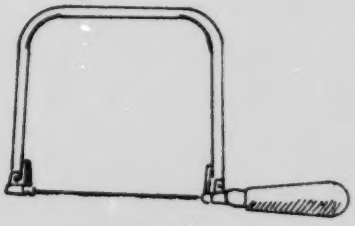
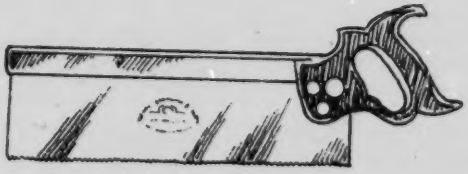


30. _____



31. _____

32. _____



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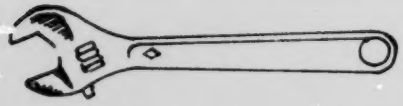

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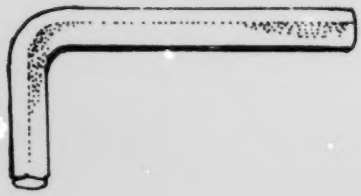

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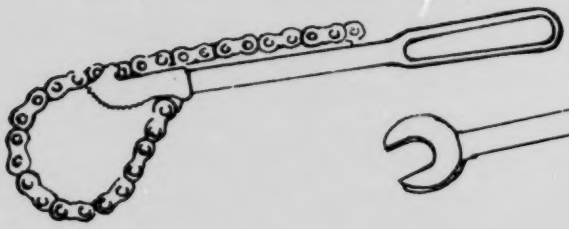

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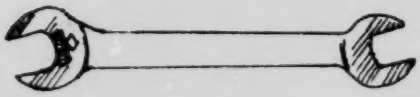

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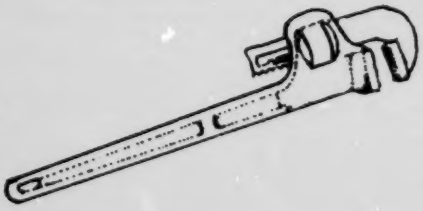

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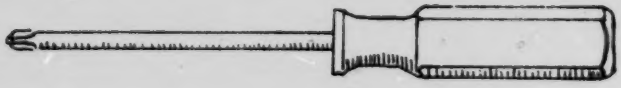

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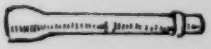

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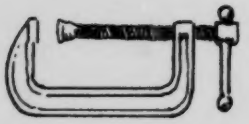

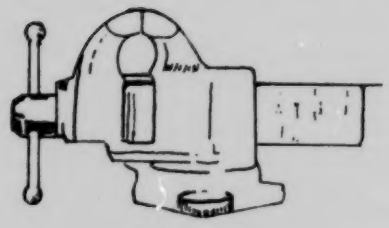

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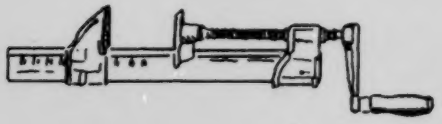

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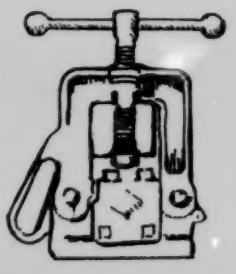

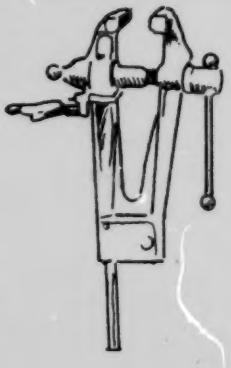

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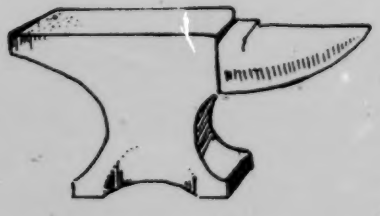

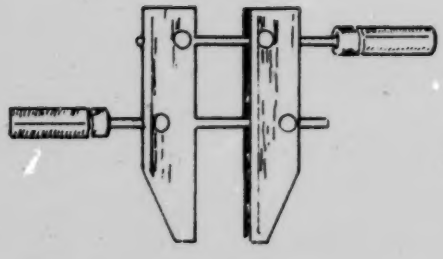

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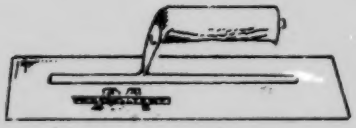

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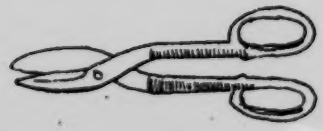

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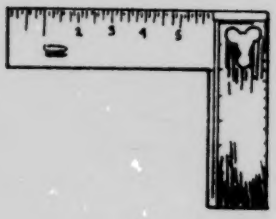

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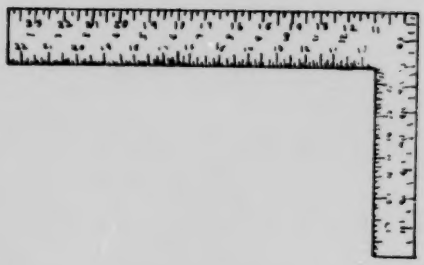

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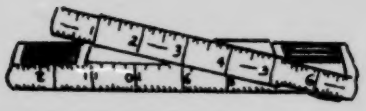

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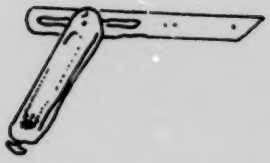

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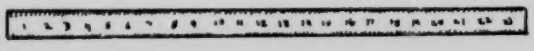

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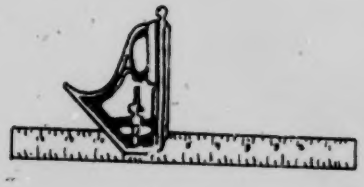

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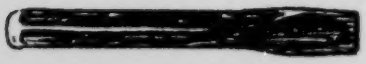

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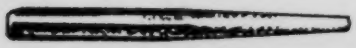

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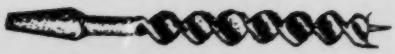

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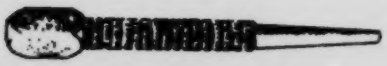

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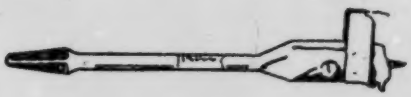

85. _____

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## STUDENT WORKSHEET 2

## IDENTIFYING HAND TOOLS

Name _____ Price _____

Give one use: _____

_____

_____

_____

Name _____ Price _____

Give one use: _____

_____

_____

_____

Name _____ Price _____

Give one use: _____

_____

_____

_____

Name _____ Price _____

Give one use: _____

_____

_____

_____

Name _____ Price _____

Give one use: _____

_____

_____

_____

Name _____ Price _____

Give one use: _____

_____

_____

_____

## STUDENT WORKSHEET 3

## HAND TOOL DEMONSTRATION

Questions:

1. Name of tool _____
2. Primary function _____
3. Can this tool be adjusted? _____

   If so, how and where? _____

   _____

   _____

4. Can tool be sharpened? _____ If so, how and where?

   _____

   _____

Observations:

List step-by-step method of correctly using the tool. Draw and identify the major parts of the tool.

_____

_____

_____

_____

_____

Conclusion:

List safety practices identified and how to properly clean and store the tool.

_____

_____

_____

_____

_____

## STUDENT WORKSHEET 4

## SHARPENING HAND TOOLS

1. Why shouldn't a wood chisel be sharpened to a longer thinner bevel than what is recommended?

   _____

2. When sharpening a tool on a grinder wheel, how should the tool to be sharpened be held?

   _____

3. What is meant by keeping a grinding wheel properly dressed? _____

   _____

4. What are three safety precautions to take when using a grinding wheel?

   a. _____

   b. _____

   c. _____

5. The standard angle of keenness for wood chisels is about _____ degrees.

6. The length of bevel of a wood chisel should be about twice the _____ of the chisel blade.

7. The cutting edge of a knife differs from a wood chisel in that the knife blade is ground on _____ and usually with a longer _____.

8. How do you joint an axe blade? _____

   _____

9. All sharpening of the auger bit is usually done with a _____.

10. Describe the difference between rip-saw teeth and cross-cut saw teeth. _____

    _____

    _____

11. What does "set of the saw" mean? _____

    _____

12. The standard angle of keenness for metal cutting tools, such as a cold chisel, is _____ degrees.

13. What does it mean to fit a screwdriver? _____

    _____

## STUDENT WORKSHEET 5

## DISCUSSION QUESTIONS ON HAND TOOLS

1. When should pliers be used in place of a wrench?

2. Why is a dull chisel more dangerous than a sharp one?

3. What determines if a screwdriver is the proper size?

4. How do you properly start and drive a nail?

5. Why should you not use a claw hammer for metal working?

6. If a hammer head is loose, how should you repair it?

7. Why should you not have anyone standing in front of you when using a hammer?

8. How should edged tools be stored?

9. Why should handles be used on files?

10. How should edged tools be carried?

## HAND TOOL PUZZLE SHEET

## I TOOL YOU SO

Fill in each blank with the name of a tool used in a workshop.

__Awl__ we __axe__ of you is that you __hammer__ away at the job of having a good time. No other ad __vise__ is necessary. If you need a new idea, __brush__ the cobwebs off your brain and __file__. You will __needle__ little __punch__. That's the __rule__. __Screw__ up your courage. Don't be as dead as a door __nail__. Try a new __tack__. __Knife__ your way through difficulties. If you do, it __augers__ well for your future. That's __plane__, isn't it? __Brace__ up! Just tell them that you __saw__ me at the WORKSHOP PARTY.

THE TOOL CHEST HAS BEEN UPSET, AND WE MUST GET IT BACK IN ORDER. The following is a group of tools with the letters disarranged. Can you straighten them out?

| | | | |
|---|---|---|---|
| rule | 1. Urel | bit | 14. Itb |
| saw | 2. Aws | screw driver | 15. Rcsew virder |
| nail set | 3. Lnai ets | wrench | 16. Cenhrw |
| hammer | 4. Memhar | square | 17. Rusqae |
| trowel | 5. Elrwot | file | 18. Life |
| plane | 6. Alnep | chisel | 19. Shicle |
| brace | 7. Careb | punch | 20. Chunp |
| awl | 8. Law | screw | 21. Rescw |
| axe | 9. Exa | nail | 22. Lina |
| vise | 10. Sive | tack | 23. Catk |
| brush | 11. Husbr | knife | 24. Finke |
| hatchet | 12. Cetthha | augers | 25. Guares |
| needle | 13. Leeend | | |

TEACHER'S KEY
STUDENT WORKSHEET 1

## TOOL IDENTIFICATION KEY

1. Straight Claw or Ripping Hammer
2. Curved Claw Hammer
3. Sledge Hammer
4. Ball Pein or Machinist's Hammer
5. Tack Hammer
6. Blacksmith's Hammer
7. Mallet or Soft Headed Hammer
8. Tinner's Hammer
9. Fence Pliers
10. Water Pump Pliers
11. Battery Pliers
12. Slip Joint Combination Pliers
13. Diagonal Pliers
14. Wire Stripper
15. Long Nose Pliers
16. Revolving or Leather Punch
17. Lineman or Electricians Pliers
18. Curved-needle nose Pliers
19. Lever-Jawed Wrench or Locking Pliers
20. Double Bit Axe
21. Shingler's Hatchet
22. Single Bit Axe
23. Broad Hatchet
24. Hand Axe
25. Glass Cutter
26. Jack Plane
27. Wood Scraper
28. Hand Saw
29. Hack Saw
30. Keyhole or Compass Saw
31. Coping Saw
32. Pruning Saw
33. Back Saw
34. Adjustable or Crescent Wrench
35. Allen or Setscrew Wrench
36. Box End Wrench
37. Chain Wrench
38. Combination End Wrench
39. Monkey Wrench
40. Open End Wrench
41. Pipe Wrench
42. Double Open End S Wrench
43. Phillips Screw Driver
44. Deep Socket
45. Extension Bar
46. Flex Handle
47. Universal Joint
48. Screw Driver
49. "C" Clamp
50. Machinist's Vise
51. Bar Clamp
52. Pipe Vise
53. Blacksmith's or Leg Vise
54. Anvil
55. Hand Screw
56. Non-metallic Cable Ripper
57. Bolt Cutters
58. Brick Trowel
59. Tubing Cutter
60. Concrete Finishing Trowel
61. Wrecking, Ripping, or Pinch Bar
62. Concrete Float
63. Tinner's Shears or Tin Snips
64. Tri Square
65. Carpenter's or Framing Square
66. Folding Rule
67. Sliding "T" Bevel
68. Steel Rule or Bench Rule
69. Carpenter's Level
70. Plumb Bob
71. Combination Square
72. Wood Rasp
73. File Card
74. Single Cut File
75. Cold Chisel
76. Taper or Triangular File
77. Wood Chisel
78. Half Round File
79. Putty Knife
80. Center Punch
81. Bit Brace
82. Drift Punch
83. Auger Bit
84. Nail Set
85. Expansion Bit
86. Pin Punch
87. Straight Shank Twist Drill
88. Prick Punch

TEACHER'S KEY
STUDENT WORKSHEET 4

## SHARPENING HAND TOOLS

1. Why shouldn't a wood chisel be sharpened to a longer thinner bevel than what is recommended?

   It is likely to chip, break or dull.

2. When sharpening a tool on a grinder wheel, how should the tool to be sharpened be held?

   Hold the tool so wheel turns toward the cutting edge.

3. What is meant by keeping a grinding wheel properly dressed?

   Clean and sharpen the wheel to keep clean particles of abrasive material exposed.

4. What are three safety precautions to take when using a grinding wheel?

   a. wear goggles

   b. use wheel guards

   c. adjust tool rest so it is close to the wheel

5. The standard angle of keenness for wood chisels is about 25 – 30 degrees.

6. The length of bevel of a wood chisel should be about twice the thickness of the chisel blade.

7. The cutting edge of a knife differs from a wood chisel in that the knife blade is ground on both sides and usually with a longer bevel.

8. How do you joint an axe blade? Lay blade flat on the tool rest with a light pressure against the wheel. Move handle back and forth as blade is moved across the stone.

9. All sharpening of the auger bit is usually done with a file.

10. Describe the difference between rip-saw teeth and cross-cut saw teeth.

    Rip-saw teeth have flat cutting edges. Cross-cut teeth have sharp points.

11. What does "set of the saw" mean?

    Bending the teeth so the cutting points are wider than the blade.

12. The standard angle of keenness for metal cutting tools, such as a cold chisel, is 60 degrees.

13. What does it mean to fit a screwdriver?

    Grinding the tip so it is square and blunt with straight sides.

## JOB SHEET 1

## IDENTIFYING AND USING HAND TOOLS

Objectives:

1. To become familiar with the names of hand tools in the school shop.
2. To know the correct uses of selected hand tools.
3. To become familiar with the cost of selected hand tools.

Materials:

1. Provide student access to the shop hand tools.
2. A supply of old hardware shop catalogs.

Procedure:

1. Give students a tour of the shop pointing out the various hand tools and their location.
2. Have each student locate a picture of each selected hand tool in an old catalog, cut it out, tape the picture on the worksheet and complete the necessary information.
3. Duplicate additional worksheet pages according to the number of hand tools the students are to identify.

## JOB SHEET 2

## HAND TOOL USE AND SAFETY

Objectives:

1. To develop an interest in hand tools.
2. To develop the ability to correctly use hand tools.
3. To appreciate a satisfactory job of using hand tools.
4. To develop ability to correctly clean, adjust and store hand tools.

Materials:

1. Selected hand tools.
2. Materials which can be used to demonstrate each hand tool (wood, metal, etc).

Procedures:

1. Demonstrate or have students demonstrate the use of selected hand tools.
2. Explain proper methods of using each tool.
3. Determine student knowledge of use and safety of each hand tool by asking students to identify safety practices.
4. Have students complete attached sheet as each hand tool is demonstrated.

## JOB SHEET 3

## SHARPENING A KNIFE

**Objective:**

Given a florist, nursery, or grafting knife, the student will sharpen the blade on an oil stone and a leather strop to a razor cutting edge in a safe, careful manner. Performance is evaluated by the teacher.

**Introduction:**

A sharp knife is important in working with plant materials so that all cuts are made in a clean and smooth manner without crushing delicate plant parts. A dull knife is more likely to slip while being used than a sharp one, so injuries are more likely to occur with a dull knive.

The knife blade is sharpened at the original angle, with all nicks carefully removed.

**Materials and Tools Needed:**

Florists, nursery, or grafting knife
Oil sharpening stone
Filled oil can
Wiping cloth
Leather razor strop

**Procedures:**

1. Assemble all the needed materials: pocket knife, oil stone, filled oil can, wiping cloth.

2. Under the direct supervision of the instructor, carefully examine the blade to find any nicks in the blade. If it is nicked, use the "coarse" side of the stone to remove them. Put a few drops of oil on the stone. Hold the blade against the stone near one end of the stone, at about a $20^{o}$ angle, cutting edge in the direction of motion. Move it evenly and smoothly the full length of the stone. Lift the blade and return it to the original position. Repeat 5 to 10 times. Turn the blade over in order to stroke the other side 5 to 10 times. Repeat alternately stroking each side of the blade until the nicks are all removed.

3. After the nicks are removed, (or do this at once if there are no nicks) turn the stone to the "fine" side and repeat the strokes as explained in Step 2.

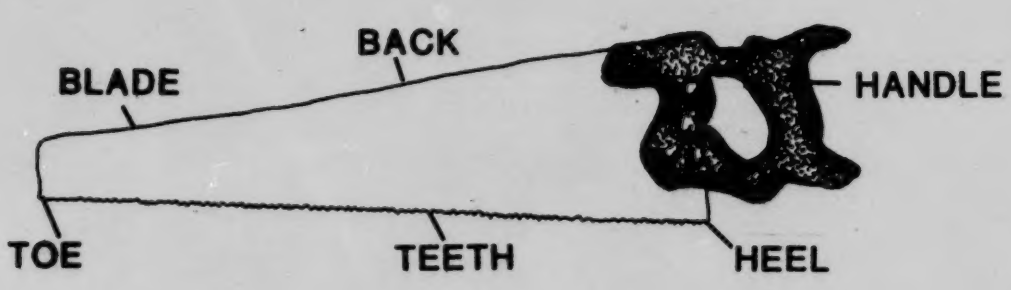
4. Test the sharpness by attempting to cut a newspaper edge with the blade. Check the tip, middle, and shank parts of the blade. Often only part of a blade may be sharp. Continue sharpening and testing until the entire cutting edge is sharp.

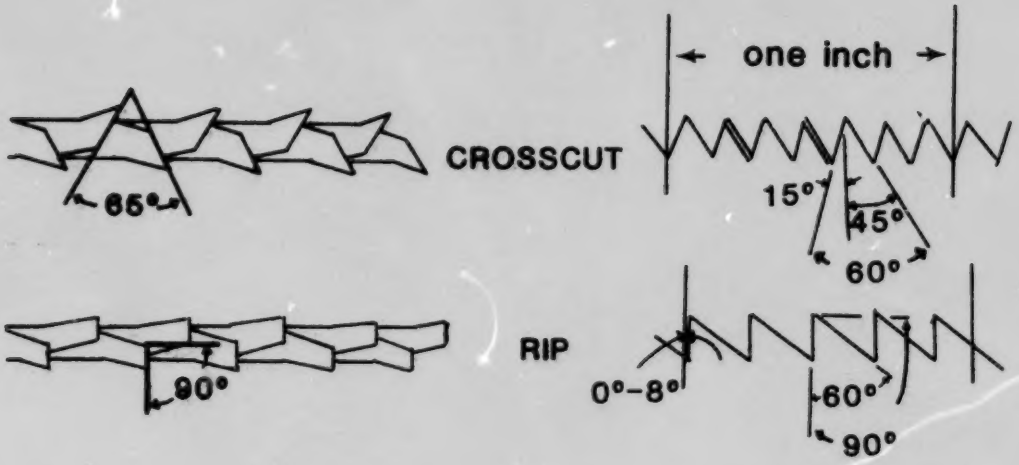
5. When the entire edge is sharp, the next step is to finish (remove burrs) with a leather razor strop. No oil is used. The motions are exactly the same as for using a stone, **except** that in this case the **back of the blade** is in the direction of the motion (otherwise, the strop will be cut!) This stropping results in a very fine edge.

6. Clean up all tools and equipment and store them.

Properly used, a stone will last many years; a circular motion in a small space of the stone will soon develop a narrow grove in the stone, ruining it.

# HAND SAWS

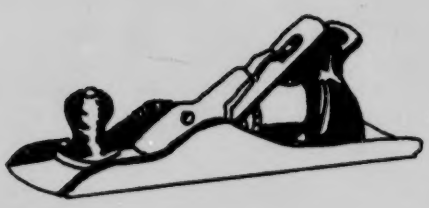


RIP SAW

CROSSCUT SAW

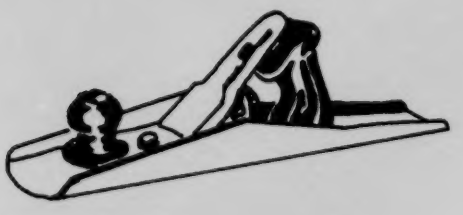
# TYPES OF HAND PLANES



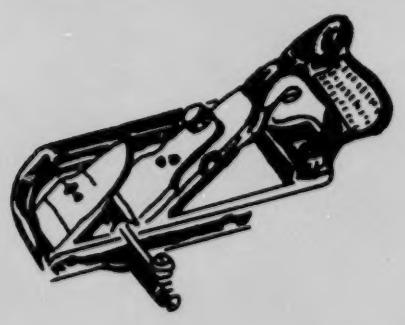
JACK

SMOOTH

BLOCK

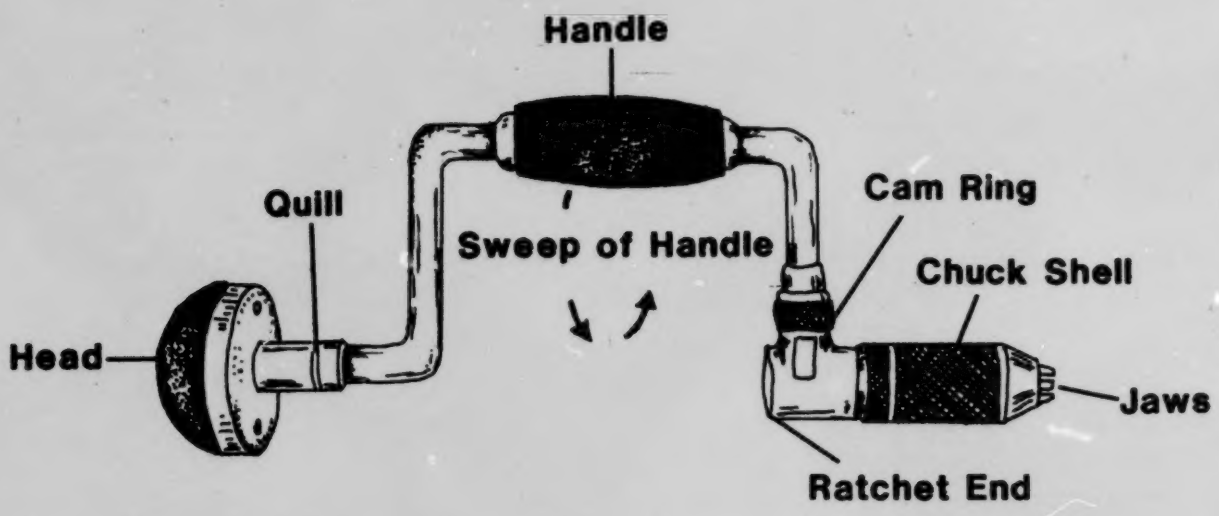


JOINTER

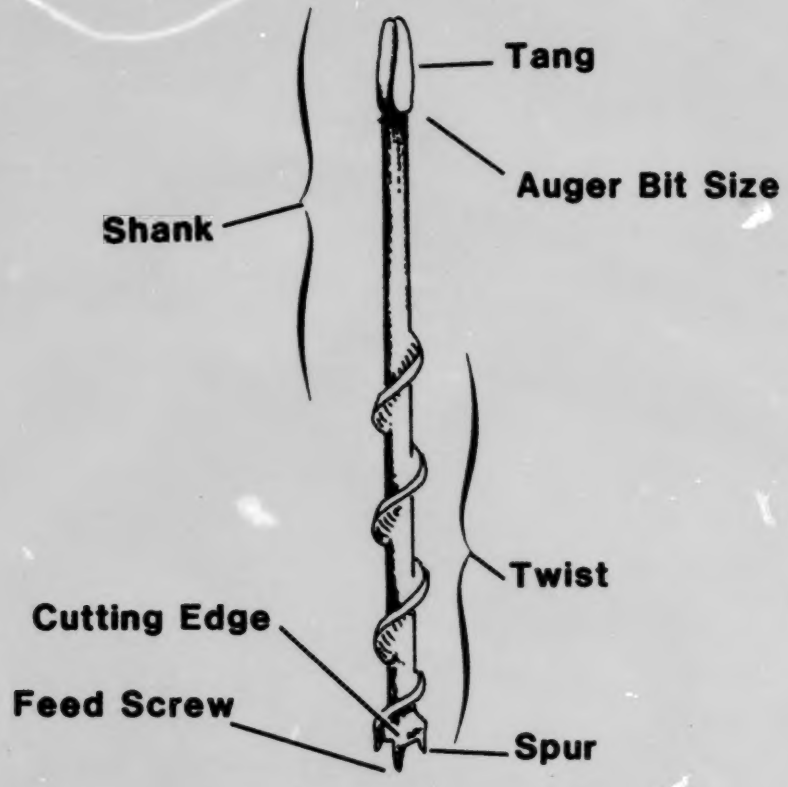


RABBET

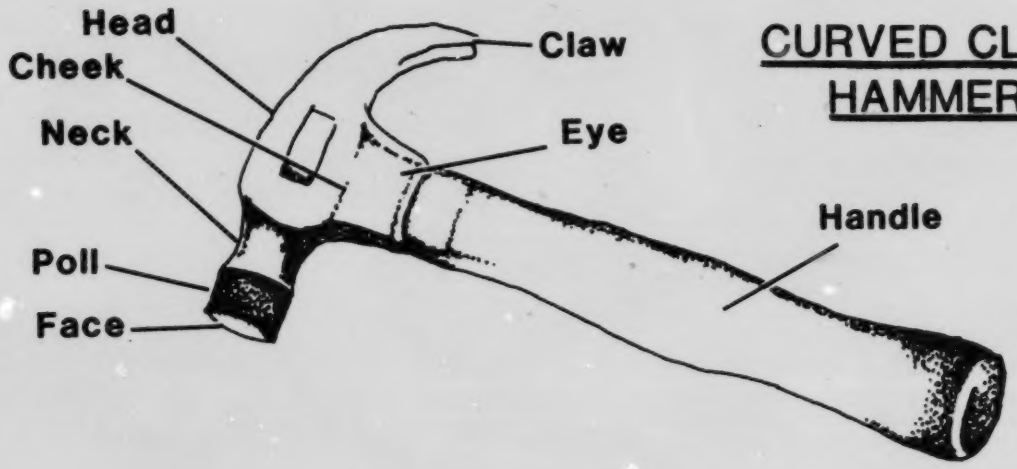
# PARTS OF THE BRACE




# PART OF THE AUGER BIT



# SELECTING NAIL HAMMERS




CURVED CLAW HAMMER

RIP HAMMER

WRECKING BAR

## DISCUSSION GUIDE FOR TRANSPARENCIES

## HAND TOOLS

I. Transparency: **Crosscut and Rip Hand Saw**

A. Explain how hand saws are important to a well-equipped shop.

1. For small or confined work, hand saws are most often better than power tools.
2. Hand saws are often better for finish work than power saws.
3. Electricity may not be available or safe in some locations.
4. Hand saws are often lighter and easier to handle than power tools.
5. Many times, a job can be completed quicker with a hand saw than with power saws.

B. It is important to understand how saws differ so the correct saw can be selected and used.

1. Saws can have curved backs or straight backs.
2. Blade lengths, measured from heel to toe vary from 18" – 26" for commonly used cross-cut saws and rip saws.
3. Most commonly used cross-cut saws have between 5 and 11 teeth per inch. Rip saws most commonly have between 4 and 7 teeth per inch.
4. Cross-cut saw teeth are shaped at different angles than rip saw teeth.
5. Rip saw teeth are perpendicular to the blade and cut like a wood chisel. The front angle can be from perpendicular to 8 degrees forward. The rear angle should be between 52 and 60 degrees.
6. Cross-cut saw teeth are angled about 65 degrees to the blade and shave the wood like a plane. The front angle is about 15 degrees and the back angle is about 45 degrees.

C. When purchasing hand saws specify:

1. rip or cross-cut
2. number of points to the inch, and
3. length of the saw

D. Correct use of hand saws:

**Rip saw**

1. Secure the material to be sawed.
2. Use the thumb on the free hand as a guide when starting a cut.

3. Hold the blade at 60 degrees to the surface of the work.

4. Place the saw on the waste side of the line. Draw the saw back until a groove is formed. Use long, steady strokes with only light pressure on the down stroke.

**Cross-cut saws**

1. Use the same procedure as the rip saw except change the angle to 45 degrees.

II. Transparency: **Types of Hand Planes**

A. Jack Plane – Most commonly used size is 14 inch length with a 2" blade.
– General purpose plane used for smoothing and jointing lumber.

B. Smooth Plane – Most commonly used size is 8 inch length with a 1 3/4 inch blade.
– Use to smooth a surface after a larger plane has been used.
– It produces a smooth but not always a true surface.

C. Block Plane – Smallest of all the planes.
– Used to plane small pieces of wood.
– Bevels, camfers, and end grain – held in one hand.

D. Jointer Plane – Largest of the planes. The length is 20 to 24 inches with blade widths of 2 3/ 8 to 2 5/8 inches.
– Used on long boards and produces a straight true edge.
– Will perform the same work as a power jointer.

E. Rabbit Plane – Most commonly used size is 8 inch length and 1/2 inch blade.
– A specialty plane which can be used to plane into corners.
– Primarily used as a finishing plane.

F. All planes use the same principle for cutting. Their main difference is in the weight, length, width, and type of blade.

III. Transparency: **Parts of the Brace and Parts of the Auger Bit**

**Braces**

A. Braces range in sizes from 6 to 14 inches with the 10-inch being the most common.

B. The size refers to the sweep of the handle.

C. Braces can be purchased with or without ratchet. The ratchet brace will permit the drilling of holes in places where a full circle cannot be made with the handle.

**Auger bit**

A. Used to bore holes in wood

B. Most common sizes are from 1/4 inch to one inch and are graduated in sixteenths. The number stamped on the tang is the numerator for the size of bit. A number 7 bit will bore a 7/16 hole.

IV. Transparency: **Selecting Nail Hammers, Parts of the Nail Hammer, Rip Hammer**

A. Most commonly used hammer in agriculture is the curved claw hammer. It is best for pulling nails and driving nails.

B. The second most popular hammer is the rip or semi-straight claw hammer. It is best for taking apart structures and driving nails.

C. Hammers range in weight from 13 to 20 ounces. The 16 ounce is the most popular weight.

D. The face of hammers may be bell faced (reducing marking of wood) or flat-faced (easier driving of the nail).

E. The handles may be made of wood, nylon, or metal. The wood handle is the least expensive and will absorb the shock which reduces tiring of the hand and arm.

**Wrecking Bar**

A. Most common size is 24 inch length.

B. Used to pry boards loose and pull nails.

C. The wrecking bar is better for pulling large nails and dismantling structures than claw hammers.

D. The wrecking bar is not a good crow bar. It is not good at prying machinery, beams, or large rocks.

## SAFETY RULES WITH HAND TOOLS

1. Use handles on files to avoid injuring your hands.
2. Be sure all machinery is stopped before adjusting.
3. Be sure wrenches fit securely to avoid slipping.
4. Replace broken handles; never repair them.
5. Always work away from your body when using chisels.
6. Do not stand in front of someone using a hammer.
7. Be sure nails are well started before using hard blows.
8. Be sure the hammer heads are tight on the handles before you use them.
9. Never use screwdrivers or files as pry-bars; select the proper tool for the job.
10. Keep edge tools sharp.
11. Use screwdrivers of the proper size.
12. Keep tool handles free from dirt, oil, and grease.
13. Do not carry edged or pointed tools in your pocket.
14. Store tools properly when you finish using them.

## SUGGESTIONS TO THE TEACHER REGARDING STUDENT TESTS ON "SAFE PRACTICES IN THE VOCATIONAL AGRICULTURE SHOP"

1. These tests have been prepared for individual power tools or areas of instruction with each test on a single sheet.

2. Most of the test questions are TRUE–FALSE types. Space has been left between questions for students to explain why the statement is true or false. It may be particularly desirable to explain why a question was marked true or false, thus re-emphasizing correct procedure.

3. A set of correct answers to the test questions is not provided. The correct answers to certain questions depend upon the safety standards adopted by individual teachers.

4. Some teachers may wish to have the students sign the attached statements of safety training and keep them on file.

5. Permission to duplicate any of this material is freely granted. Credit for the material used in this unit is due to many individual teachers. Original drafts were submitted by A. W. Schmidt, D. J. Witt, Loren Mills, and Charles Pearson, Teachers of Vocational Agriculture in Illinois.

Name _____

Date _____

# STUDENT TEST
# ON
# HAND TOOLS

TRUE or FALSE

_____ 1. A dull eged tool may be more dangerous than a sharp one.

_____ 2. You should check the condition of any tool, as to its safety, before using it.

_____ 3. You should always cut toward yourself when using an edged tool to avoid dulling the tool.

_____ 4. It is all right to use a hammer with a poor handle, if that handle is fastened on tight.

_____ 5. It is all right to hammer on a wrench with a ball-peen hammer, but not with a claw hammer.

_____ 6. It is safer to use both hands on a screwdriver.

_____ 7. It is not safe to use files without handles.

_____ 8. In using adjustable end wrenches, have the jaws facing the direction of pull.

_____ 9. You should keep your fingers flat against the board when holding a nail for starting with a hammer.

_____ 10. If you discover a defective hammer handle in the shop, you should toss it aside and get another hammer.

## UNIT H: AGRICULTURAL MECHANICS

## PROBLEM AREA: USING SELECTED POWER TOOLS

### SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with freshman or beginning students enrolled in an agricultural/horticultural occupations program. The recommended time for teaching this problem area is during the early winter. The estimated time for teaching this problem area is 3 to 10 days depending on how much time the teacher wishes to spend on discussion and conducting the suggested exercises. The materials in this problem area were selected and written with the following assumptions:

1. It is important for all agriculture students to be able to identify common power tools used in agriculture and their parts.

2. Students need instruction on the safe use and care of power tools at the freshman level.

The instructor is reminded that this problem area includes power tools used on the farm and in urban areas. The items in this problem area are for reference or modification as the teacher adapts this material to his/her local situation.

### CREDIT SOURCES:

These materials were developed through a funding agreement, R-33-21-D-1542-388 with the Illinois State Board of Education, Department of Adult, Vocational and Technical Education, Research and Development Section, 100 North First Street, Springfield, Illinois 62777. Opinions expressed in these materials do not reflect, nor should they be construed as policy or opinion of the State Board of Education or its staff.

The teacher's guide, worksheets, transparency discussion guides were developed by Paul Benson, Jerry Pepple, and Jim Ethridge, Department of Vocational and Technical Education, University of Illinois. The transparency masters and suggested test questions were prepared by Vocational Agriculture Service, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Rural and Metropolitan Core Curriculum Pilot Test Teachers.

## TEACHER'S GUIDE

I. Unit: Agricultural mechanics

II. Problem area: Using selected power tools

III. Objectives: At the close of the problem area, students will:

1. Be able to identify and list parts of selected power tools.
2. Be able to use proper procedures in the operation of selected power tools.
3. Understand the safety instructions for proper use of selected power tools.

IV. Suggested interest approaches:

1. Collect an assortment of power tools and have students identify them.
2. Lead into a discussion by asking students what power tools they have at home.
3. Ask students how they could get physically hurt with certain power tools.
4. Ask the students if they have been involved in any accidents when using power tools.
6. Ask students if they know the approximate cost of each power tool and then have them figure a total value for their home power tools.
7. Have a display of boards or pieces of metal that have been cut or drilled with power tools.
8. Prepare a bulletin board display indicating various kinds of power tools used in the agricultural service areas.
9. Discuss the issues involved in using your own tools as compared to hiring the work done or renting the tools.
10. Develop a list of power tools found at local businesses and identify the common ones; then have the students learn how to operate these tools.

V. Anticipated problems and concerns of students:

1. What power tools are we going to learn to operate?
2. How are each of these tools used and operated?
3. What safety precautions should we use in operating these tools?
4. How should these tools be maintained and stored?
5. What shop rules should I follow when using power tools?
6. How do you change a blade on the power saw?
7. Additional problems and concerns are included in Worksheets 1 – 5. Students could be referred to these worksheets to obtain additional problems and concerns.

VI. Suggested learning activities and experiences:

1. Discuss problems and concerns identified by class or teacher and develop appropriate answers. Have class consider questions on Worksheets 8, 9 and 10.

2. Have class read VAS Unit 3022 "Safety in the Agricultural Mechanics Shop," Sections 7, 8, 11, 13, and 14.

3. Distribute Worksheet No. 1, "Safety Instructions for Operating Power Tools," and have class fill out and discuss. Use Job Sheet 1 and Worksheet 2 to identify additional power tools.

4. Show transparencies. Identify various parts of each power tool and explain the correct procedures for its use.

   a. Table Circular Saw
   b. Table Saw Blades
   c. Bench Model Drill Press

5. Show filmstrips:

   VAS 461 "Drill Press"
   VAS 462 "Circular Saw"
   VAS 463 "Power Grinder"
   VAS 498 "Using Power Lawn Mowers Safely"
   VAS 633 "Identifying and Using Horticultural Hand Tools"

6. Have each student demonstrate the proper and safe use for each power tool. For example, for the table saw, provide each student with a board and have them cut one end and one side so they are square. Use Job Sheet 2 and Worksheet 3.

7. Hand out Worksheets 4, 5, 6, and 7. Have students go into the shop and fill out. Discuss their results with the class.

8. Arrange for students to conduct an area survey of businesses using power tools in each of the service areas. Use the information gathered by the students in conducting your instruction. Use Worksheets 11–19 for business survey.

9. Use pictures, films, filmstrips, slides and/or actual power tools in demonstrating or discussing their safe and proper use. Identify occupational activities in which the students would use each power tool.

10. Ask students to demonstrate their ability to safely use and adjust certain power tools.

VII. Application procedures:

1. The main purpose of this problem area is to learn to recognize and use power tools in a proper and safe manner.

2. The students should apply their knowledge and understanding learned in the shop to their own power tools or to those in a place of employment.

VIII. Evaluation:

1. Prepare and administer a pencil and paper test covering the identification of power tools and their parts and the proper use of power tools.

2. Grade worksheets

3. Prepare and administer laboratory practical exam on identification and proper use of power tools.

4. Administer VAS Safety Test. "Safe Practices in the Vocational Shop" (sections on specific power tools)

IX. References and Aids:

1. VAS Unit 3022 "Safety in the Agricultural Mechanics Shop" (Sections 7, 8, 11, 13, 14)

2. VAS Safety Test "Safe Practices in the Vocational Agriculture Shop." Series on power tools.

3. VAS Transparencies on Power Tools.

4. Power Tool Student Worksheets 1 – 19.

5. Job Sheets 1 and 2.

6. VAS Charts on Safety Rules for Power Tools.

7. Phipps, Loyd J., Mechanics in Agriculture, The Interstate Printers, Danville, Illinois.

8. VAS Filmstrip 633 on "Identifying and Using Horticultural Hand Tools."

9. VAS Filmstrip 498, "Using Power Lawn Mowers Safely."

10. VAS Filmstrip 463, "Power Grinder"

11. VAS Filmstrip 462, "Circular Saw"

12. VAS Filmstrip 461, "Drill Press"

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9. VAS Filmstrip 498, "Using Power Lawn Mowers Safely."

10. VAS Filmstrip 463, "Power Grinder"

11. VAS Filmstrip 462, "Circular Saw"

12. VAS Filmstrip 461, "Drill Press"

## STUDENT WORKSHEET 1

## SAFETY INSTRUCTIONS FOR OPERATING POWER TOOLS

1. Blade height for a tilting arbor table saw should be just high enought to clear the work by no more than _____ inches.

2. When can more than one person be inside the "safety zone" lines of the table saw?

   _____

3. What dress precautions should be taken when using the table saw?

   _____

   _____

4. When should a push stick be used with a table saw?

   _____

5. What are the three main types of sabre saw blades?

   a. _____

   b. _____

   c. _____

6. What should you remember to do before adjusting or repairing any power tool?

   _____

7. To stop a portable sander, you should _____ and then turn the switch off.

8. You should have at least _____ inches of leverage before holding any work to be drilled.

9. Check, and if necessary, adjust _____ before starting a grinder.

10. A tool rest shou'd be _____ inches away from the face of the wheel?

11. Grind only on the_____ of the wheel.

12. Use_____ to hold small objects against the wheel.

## STUDENT WORKSHEET 2

## IDENTIFYING POWER TOOLS

Name _____ Price _____ Name _____ Price _____

Give one use: _____ Give one use: _____

_____ _____

_____ _____

_____

Name _____ Price _____ Name _____ Price _____

Give one use: _____ Give one use: _____

_____ _____

_____ _____

_____

Name _____ Price _____ Name _____ Price _____

Give one use: _____ Give one use: _____

_____ _____

_____ _____

_____

## STUDENT WORKSHEET 3

## POWER TOOL DEMONSTRATION

Questions:

1. Name of tool _____
2. Primary function _____
3. Can this tool be adjusted? _____

   If so, how and where? _____

   _____

   _____

4. Can tool be sharpened? _____ If so, how and where?

   _____

   _____

Observations:

List step-by-step method of correctly using the tool. Draw and identify the major parts of the tool.

_____

_____

_____

_____

_____

Conclusion:

List safety practices identified and how to properly clean and store the tool.

_____

_____

_____

_____

_____

## STUDENT WORKSHEET 4

## TILTING ARBOR SAW INFORMATION SHEET

Manufacturer's Name _____ Model _____ Size _____

1. What type of blade is in the saw?

2. What is the diameter of the saw blade?

3. What is the diameter of the arbor?

4. What other blades are available in the shop?

5. What is the deepest cut possible?

6. How is the blade raised and lowered?

7. How is the arbor tilted?

8. How far will the arbor tilt?

9. On what part are the saw guard and anti-kick-back fingers mounted?

10. How is the rip fence locked?

11. What is the use of the slot parallel to the blade?

12. What is the speed of the blade in RPM?

13. What is the horsepower rating of the motor?

14. What type of switch turns the saw on and off?

15. How many volts are passing through this switch?

## STUDENT WORKSHEET 5

## POWER GRINDER INFORMATION SHEET

Manufacturer's Name _____ Model _____ Size _____

1. What is the abrasive material from which the wheel is made?

2. What is the diameter of the wheel?

3. What is the width of the wheel's face?

4. What is the diameter of the motor shaft?

5. What is the horsepower rating of the motor?

6. What is the RPM speed of the motor?

7. What type of switch turns the grinder on and off?

8. How many volts are passing through the switch?

## STUDENT WORKSHEET 6

## DRILL PRESS INFORMATION SHEET

Manufacturer's Name _____ Model _____ Size _____

1. What is the largest diameter of the end of a bit that can be held in the chuck?

2. What is the largest size of hole that can be drilled in cast iron?

3. What is the largest size of hole that can be drilled in steel?

4. What is the distance of quill travel (stroke)?

5. What is the horsepower rating of the motor?

6. What is the RPM speed of the motor?

7. What spindle speeds are available?

8. How is the spindle speed changed?

9. What type of switch turns the drill press on and off?

10. How many volts are passing through this switch?

## STUDENT WORKSHEET 7

## PORTABLE CIRCULAR SAW INFORMATION SHEET

Manufacturer's Name _____ Model _____ Size _____

1. What type of blade is in the saw?

2. What is the diameter of the blade?

3. What other types of blades are available in the shop?

4. Where is the blade wrench kept?

5. What is the maximum depth of cut?

6. How is the depth of cut adjusted?

7. How is the angle of cut adjusted?

8. Does this saw have a brake?

   How is it activitated?

9. Does this saw have a kick-proof clutch?

10. What is the motor's ampere rating?

11. What is the motor's idle speed in RPM?

## STUDENT WORKSHEET 8

## DISCUSSION QUESTIONS ON BAND SAWS

1. Who should be allowed within the saw's "safety zone" area?

2. How is the band saw's safety zone marked?

3. Why is loose clothing dangerous when operating a band saw?

4. Why should stock be pushed and not pulled through a band saw?

5. What should be done before you begin to cut stock with a band saw?

6. Why should you not cut round stock on a band saw?

7. How far should the saw guide be from the stock? Why?

8. What adjustments can be made on the band saw?

9. How do you change the blade on the band saw?

10. What problems result from cutting with dull blades?

## STUDENT WORKSHEET 9

## DUSCUSSION QUESTIONS ON PORTABLE JIG SAWS

1. What checks should be made of the work area before you start to use the jig saw?

2. What are the three types of blades which can be used with jig saws?

3. What type of clothing should be worn when using the jig saw?

4. Describe the procedure for attaching the blade to the jig saw.

5. How should the jig saw be cleaned and lubricated?

6. Describe the procedure to follow when metal cutting with jig saws.

7. When should the rip fence be used with jig saws?

8. What adjustments can be made on the jig saw?

9. How can material be secured for cutting with a jig saw?

10. Describe how to make an inside cut with a jig saw.

## STUDENT WORKSHEET 10

## DISCUSSION QUESTIONS ON ELECTRIC SANDERS

1. Can the motor be locked on for continuous sanding? If so, how?

2. Describe how to change the belt on a belt sander.

3. Describe how to adjust the "tracking" of the belt on a sander.

4. Why should the dust collector be kept clean?

5. Describe how to properly clean a belt sander.

6. Why should you not start and stop the belt sander while it is resting on the stock?

7. Explain how to properly attach sanding paper to a disk sander.

8. Describe how to properly secure and sand small stock.

## STUDENT WORKSHEET 11

## DISCUSSION QUESTIONS ON THE SOIL SHREDDER

1. What will the soil shredder shred?

2. What is the proper clothing to wear when shredding soil?

3. How do I sharpen the hammer flails?

4. How many people does it take to operate a soil shredder?

5. How do I properly operate the soil shredder?

6. How do I properly maintain the soil shredder?

7. What materials should not be put through the soil shredder?

8. How should materials be prepared for shredding?

## STUDENT WORKSHEET 12

## DISCUSSION QUESTIONS ON THE WEED TRIMMER

1. What guards are provided on the electric weed trimmer?

2. What are the advantages of an automatic line feed trimmer?

3. What hazards are involved in operating a weed trimmer?

4. What is an extension cord connector?

5. At what angle should the electric trimmer be slanted for the most effective trimming?

6. In what direction should the weed trimmer be operated and why?

7. What is the proper method of trimming along fences?

8. How do you rewind and install a nylon line and the disk?

9. What maintenance program should be followed on the weed trimmer?

## STUDENT WORKSHEET 13

## DISCUSSION QUESTIONS ON THE CONCRETE MIXER (SOIL MIXER)

1. What is the maximum cubic feet that a soil mixer will handle?

2. How do I operate a soil mixer?

3. Why is a concrete mixer used for mixing soil?

4. What maintenance program should be followed on a soil mixer?

5. What adjustments can be made on a soil mixer?

6. What hazards are involved in operating a soil mixer?

7. Can the soil be over-mixed? What is done when the soil is over-mixed?

8. How many people should operate a soil mixer?

## STUDENT WORKSHEET 14

## DISCUSSION QUESTIONS ON THE ROTARY TILLER

1. What is the correct procedure to use in starting a gasoline rotary tiller?

2. What is the recommended speed for rotary tilling?

3. How deep should the rotary tiller dig?

4. How do I force the rotary tiller into the ground?

5. How do I remove or add on additional cutting blades?

6. What is the drag bar on the rotary tiller?

7. What are the capabilities of an electric rotary tiller?

8. What are the hazards in operating a rotary tiller?

9. How can the electric rotary tiller be adapted to operate as a de-thatcher?

## STUDENT WORKSHEET 15

## DISCUSSION QUESTIONS ON THE SOIL STERILIZER

1. How is soil media prepared for the soil sterilizer?

2. What precautions should be taken when operating an electric soil sterilizer?

3. What unsafe actions should be avoided when operating a soil sterilizer?

4. What temperatures are required to kill different organisms in a soil sterilizer?

5. How much time is required to sterilize soil?

6. Can a soil sterilizer be filled, turned on, and then left unattended?

7. What hazards can occur if sterilized soil is removed before allowing it to cool?

8. What additional checks can be made to insure that the soil sterilizer is operating correctly?

## STUDENT WORKSHEET 16

## DISCUSSION QUESTIONS ON THE CHAIN SAW

1. What different sizes of chain saws are available?

2. What size of chain saw should be used for what size of limbs or tree trunk?

3. What type of clothing should be worn when operating a chain saw?

4. How does one prepare a tree for felling?

5. What precautions should be taken before starting the chain saw?

6. How is the chain of the saw lubricated and sharpened?

7. What special safety precautions should be observed when operating an electric chain saw?

8. How is the fuel mixed for chain saws?

9. What safety precautions must be taken when using a chain saw to prune trees?

## STUDENT WORKSHEET 17

## DISCUSSION QUESTIONS ON THE LAWN EDGER

1. Why must eye protection be used when using a lawn edger?

2. How can "outdoor" extension cords be identified?

3. What is an extension cord retainer?

4. How do I attach a blade to a lawn edger?

5. How do I change the position of the cutting head?

6. What chemicals will cause the blades to corrode? How do I prevent corrosion?

7. How do I clean and lubricate the lawn edger?

8. What hazards are involved in using a lawn edger?

## STUDENT WORKSHEET 18

## DISCUSSION QUESTIONS ON THE ELECTRIC AND GASOLINE LAWN MOWERS

1. What are the advantages of an electric and gasoline lawn mower?

2. What is the proper dress when operating any lawn mower?

3. How do I sharpen a lawn mower blade?

4. What safety shield should be on the lawn mower?

5. How do I maintain the electric and gasoline lawn mowers?

6. What are the hazards in using each of the lawn mowers?

7. How do I determine when my lawn mower blade needs sharpening?

8. What is the proper method of mowing slopes?

9. How do I determine at what height my lawn should be mowed?

10. How do I adjust the height of my lawn mower?

## STUDENT WORKSHEET 19

## DISCUSSION QUESTIONS ON THE HEDGE TRIMMER

1. How often does a hedge trimmer need to be sharpened?

2. How should a hedge trimmer be sharpened?

3. How do I operate an energy pack for a hedge trimmer?

4. What should I do if I drop an electric hedge trimmer?

5. How do I properly trim a hedge and operate the hedge trimmer?

6. How do I lubricate the hedge trimmer?

7. How do I clean the hedge trimmer after the work is completed?

8. What are the hazards in operating a hedge trimmer?

9. What is the proper dress for a person operating a hedge trimmer?

10. How many people should it take to operate a hedge trimmer properly?

TEACHER'S KEY
STUDENT WORKSHEET 1

## SAFETY INSTRUCTIONS FOR OPERATING POWER TOOLS

1. Blade height for a tilting arbor table saw should be just high enought to clear the work by no more than 1/4 inches.

2. When can more than one person be inside the "safety zone" lines of the table saw?

   Instructor has assigned a helper to assist the operator.

3. What dress precautions should be taken when using the table saw?

   Do not wear gloves, long loose sleeves, neckties, or rings. Keep shirt tucked in trousers.

4. When should a push stick be used with a table saw?

   When board is to be ripped.

5. What are the three main types of sabre saw blades?

   a. woodcutting

   b. metal cutting

   c. knife blade

6. What should you remember to do before adjusting or repairing any power tool?

   Disconnect the cord.

7. To stop a portable sander, you should lift it from the work and then turn the switch off.

8. You should have at least 12 inches of leverage before holding any work to be drilled.

9. Check, and if necessary, adjust tool rest before starting a grinder.

10. A tool rest should be 1/8 inches away from the face of the wheel?

11. Grind only on the face of the wheel.

12. Use pliers to hold small objects against the wheel.

## JOB SHEET 1

## IDENTIFYING AND USING POWER TOOLS

Objectives:

1. To become familiar with the names of power tools in the school shop.
2. To know the correct uses of selected power tools.
3. To become familiar with the cost of selected power tools.

Materials:

1. Provide student access to the shop power tools.
2. A supply of old hardware shop catalogs.

Procedure:

1. Give students a tour of the shop pointing out the various power tools and their location.
2. Have each student locate a picture of each selected power tool in an old catalog, cut it out, tape the picture on the worksheet and complete the necessary information.
3. Duplicate additional worksheet pages according to the number of power tools the students are to identify.

## JOB SHEET 2

## POWER TOOL USE AND SAFETY

Objectives:

1. To develop an interest in power tools.
2. To develop the ability to correctly use power tools.
3. To appreciate a satisfactory job of using power tools.
4. To develop ability to correctly clean, adjust and store power tools.

Materials:

1. Selected power tools.
2. Materials which can be used to demonstrate each power tool (wood, metal, etc).

Procedures:

1. Demonstrate or have students demonstrate the use of selected power tools.
2. Explain proper methods of using each tool.
3. Determine student knowledge of use and safety of each power tool by asking students to identify safety practices.
4. Have students complete attached sheet as each power tool is demonstrated.

## SAFETY RULES WITH POWER TOOLS

## TILTING ARBOR SAW

1. Keep saw guard in place unless you have instructor's permission to remove it.

2. Do not saw free hand—use the rip fence or miter gauge.

3. Adjust blade to clear work 1/4 to 1/2 inch only.

4. Use the push stick.

5. Never allow your fingers to go beyond the orange line when ripping.

6. Never use the fence as a length stop for cross cutting.

7. Never clear away scraps from a turning blade with your fingers.

8. Disconnect power before handling blade.

9. Make no adjustments with saw running.

10. Stand so your face is not in the direct line of cut.

## SAFETY RULES WITH POWER TOOLS

## PORTABLE ELECTRIC CIRCULAR SAWS

1. Keep blade sharp at all times.

2. Keep guards in place and working at all times.

3. Check regularly for cracked blades.

4. Keep power cord clear of working area.

5. Do not over reach; keep well balanced and have good footing.

6. Do not start or stop saw with the blade in contact with the stock.

7. Keep both hands on the saw and away from the blade and line of cut.

8. Never lay the saw down until it stops turning.

9. Disconnect the power source before making any adjustments.

10. Always wear safety glasses when sawing.

11. Keep other workers at a safe distance from the work area.

12. Always use proper size and type of blade for the work being done.

## SAFETY RULES WITH POWER TOOLS

## GRINDER

1. Wear safety goggles or a face shield when using the grinder.
2. Adjust tool rests to be firm, slightly above wheel center and not over 1/8 inch from wheel.
3. Stand clear and let grinder run a full minute before starting to grind.
4. Grind only on face of wheel—never on the side.
5. Keep grinding wheels properly dressed and trued.
6. Do not hold small pieces in your hand for grinding.
7. Keep fingers away from face and eyes until abrasive dust has been carefully washed off.
8. Make no adjustments with grinder running.
9. Stand so your face is not in direct line with the grinding wheel.
10. Do not leave grinder until it has come to a full stop.

## SAFETY RULES WITH POWER TOOLS

## DRILL PRESS

1. Keep drills properly ground and sharp.
2. Tighten chuck securely and remove chuck key before starting drill press.
3. Do not hold pieces by hand unless you have at least 12 inches leverage.
4. Keep hair, neckties, sleeves, etc., secured.
5. Keep belt guards always in place.
6. Operate drill press only at speed recommended for the particular job.
7. Avoid forcing a drill, especially just as it cuts through.
8. Keep floor around drill press free from oil and scrap materials.
9. Wear safety goggles or a face shield when drilling at high speeds.
10. Remove shavings and chips from drill press table with brush—not your hands.

## SAFETY RULES WITH POWER TOOLS

### BAND SAWS

1. Keep other workers outside the saws "safety zone" area.
2. Remove or secure loose clothing, aprons, and ties.
3. Check the blade for free movement and trueness before turning on the power.
4. Keep fingers at least 2 inches from the blade when cutting.
5. Keep fingers away from the direct line of cut with the blade.
6. Use a push stick.
7. Do not pull the stock through from the back of the blade.
8. Keep saw clean and free of oil, grease, and scrap material.
9. Keep saw guide within one-half inch of the stock being cut.
10. Keep all guards in place.
11. Do not saw round stock on a band saw.

## SAFETY RULES WITH POWER TOOLS

## PORTABLE JIG SAWS

1. Be sure all connections are adequately grounded and are safe.
2. Keep saw clean and dry.
3. Keep all parts and screws tight.
4. Be sure blade is locked securely before starting to work.
5. Be sure work is solidly supported.
6. Keep the saw shoe firmly against the work when operating the saw.
7. Be sure all adjusting keys and wrenches are removed from the saw before turning it on.
8. Move the saw forward rapidly enough to keep the blade cutting; do not force the saw.
9. Use safety glasses when cutting material.
10. Keep hands away from the cutting area.
11. Keep the electrical cord clear of the cutting area.

## SAFETY RULES WITH POWER TOOLS

## ELECTRIC SANDERS

### DISK SANDERS

1. Sand only on the downstroke side of the disk.
2. Do not hold small stock in your hand while sanding.
3. Always stop and unplug the sander to clean, adjust, or repair it.
4. Make sure the sander has stopped before laying it down or leaving it.
5. Never touch a moving sanding disk.
6. Always wear safety glasses when sanding.

### BELT SANDERS

1. Check belt for proper adjustment and movement before operating.
2. Secure stock firmly before sanding.
3. Check dust collector and clean, if necessary, before sanding.
4. Do not start or stop the sander while it is resting on the stock.
5. Always wear safety glasses when sanding.
6. Never hold small stock in your hand while sanding.

## SAFETY RULES WITH POWER TOOLS

## SOIL SHREDDER

1. Do not place dry soil components into the soil shredder.

2. Do not place rocks or coarse bark into a soil shredder.

3. Wear safety goggles while operating a soil shredder.

4. Wear protective shoes, shirt and pants while operating a soil shredder.

5. Keep the free-swinging flail action hammers sharp.

6. Check before each operation, to see that the "Release-On-Impact" shredding mechanism is in operating condition.

7. Check and properly secure the screen attachement before turning on the machine.

8. Adjust the legs of the machine to insure the shredder is firmly secured and balanced.

9. Stand clear and let the soil shredder run a full minute before starting to shred soil media.

10. Keep fingers away from the hammer flails in the machine.

11. Make no adjustments while the soil shredder is running.

12. Stand so your face is not in direct line with the flail hammers.

13. Do not leave the work area until the soil shredder has come to a full stop.

## SAFETY RULES WITH POWER TOOLS

## ELECTRIC WEED TRIMMER

1. Safety glasses or goggles should be worn at all times when trimming.

2. Do not use the weed trimmer without the guard attached.

3. Keep your hands, face and feet clear of the rotating nylon line at all times.

4. Keep bystanders at a safe distance from the work area.

5. Do not carry a plugged in tool with your finger on the trigger.

6. Do not force the tool at a rate faster than the rate it is able to cut effectively.

7. To prevent electric shock hazard, use only with an extension cord suitable for outdoor use.

8. Do not yank the cord from the receptacle. Keep the cord from heat, oil, and sharp edges.

9. Keep the cord away from the rotating nylon cord.

10. Disconnect the weed trimmer when not in use, while lengthening line, prior to cleaning, and when removing or replacing the spool containing the line.

11. Do not operate the trimmer when barefoot or wearing open sandals.

12. Do not operate the weed trimmer in damp or wet locations.

13. Do not use the trimmer in the rain.

14. Store the idle weed trimmer indoors when not in use. The storage should be out of the reach of children or locked up.

## SAFETY RULES WITH POWER TOOLS

## CONCRETE MIXER

1. Use only grounded outlets when operating a concrete mixer (soil mixer).

2. Do not operate in barefeet or open sandals.

3. Wear safety goggles or glasses when operating the soil mixer.

4. Stand clear and let the soil mixer run a full minute before starting to mix your soil media.

5. Add additional materials to the barrel only when the machine has come to a complete stop.

6. Keep fingers away from all moving parts.

7. Do not wear loose or floppy clothing that might get entangled in the moving parts of the soil mixer.

8. Make no adjustments to the soil mixer while it is running.

9. Always have at least two people operating the soil mixer at a time.

10. Do not leave the soil mixer until it has come to a full stop.

## SAFETY RULES WITH POWER TOOLS

## ROTARY TILLER

1. Study the operator's manual carefully before operating the rotary tiller.

2. When operating the rotary tiller, give it your undivided attention.

3. Never leave the rotary tiller running unattended.

4. Keep children and pets clear of the rotary tiller.

5. Never allow children or pets to run alongside or in front of the rotary tiller.

6. Keep hands and feet away from cutting blades at all times.

7. Never clean or perform maintenance work on the rotary tiller without first removing the spark plug wire from the plug.

8. If a carburetor adjustment is necessary, disengage the clutch lever and stand to one side, keeping hands and feet away from the cutting blades.

9. When starting the engine make sure the clutch lever is in neutral.

10. Never run the engine in a poorly ventilated place. The exhaust gases contain carbon monoxide which is an odorless and deadly gas.

11. Stop the engine and disengage the clutch if, at any time, it becomes necessary to use hands or feet near the cutting blades.

12. Stop the engine and disengage the clutch when transporting the rotary tiller.

## SAFETY RULES WITH POWER TOOLS

## SOIL STERILIZER

1. Wear safety goggles or face shield when using the soil sterilizer.

2. Adjust the location of the sterilizer to rest firmly on the floor.

3. Check the temperature gauge to see that the machine is working properly before you put the machine into operation.

4. Do not compact the soil media into the sterilizer.

5. Moisten the soil to ready it for planting before sterilization.

6. Do not place your hand into the sterilizer to check heating elements while it is in operation.

7. Make no adjustments while the machine is plugged into the receptacle or within 15 minutes after the machine has been unplugged and emptied.

8. When opening the lid of the sterilizer, stand so your face is not in direct line of the steam that will escape.

9. Do not leave the sterilizer unattended while in operation.

10. Do not operate the sterilizer in bare feet or with open faced sandals.

11. Do not operate the sterilizer while standing on a wet floor.

12. Allow the soil media to cool before removing it from the soil sterilizer.

## SAFETY RULES WITH POWER TOOLS

### CHAIN SAW

1. Follow steps in the instructional manual for operation and maintenance of your chain saw.
2. Wear protective clothing.
3. Have a first-aid kit available.
4. Remove nails, wire, etc. from the trunk before sawing.
5. Determine where the tree or limb will fall before you begin sawing.
6. Select a safe place to stand when the tree or limb falls.
7. Clear debris from around the tree.
8. Notch the tree on the side in the direction of the fall, then make your corner cuts and cut back.
9. Yell "Timber!" as the tree falls.

### SAFETY RULES FOR ELECTRIC–POWERED CHAIN SAWS

1. Read the manual supplied with your saw.
2. Use a heavy-duty, 3-wire, outdoor extension cord for power tools.
3. Be careful not to trip on the cord.
4. Disconnect the cord while moving from one plant to another.
5. Do not cut through the cord.
6. Do not use this tool while standing in a wet area.

## SAFETY RULES WITH POWER TOOLS

## ELECTRIC LAWN EDGER

1. Safety glasses or goggles should be worn at all times when using a lawn edger.
2. Do not use the lawn edger without the guard in place.
3. Keep your face, hands and feet away from the cutting area at all times.
4. Wear long pants to protect your legs.
5. Keep all bystanders away and at a safe distance from the work area.
6. Do not carry a "plugged-in" lawn edger with your finger on the trigger. Keep your finger off the trigger when plugging in the machine.
7. Do not force the tool at a faster rate than it is able to edge effectively.
8. Keep a proper footing and balance at all times. Do not over-reach.
9. Do not yank the cord from the receptacle. Keep the cord from heat, oil, and sharp edges.
10. To prevent disconnection of the extension cord during operation, use an extension cord retainer.
11. Keep the lawn edger cord away from the moving blade.
12. Use only 3 wire "outdoor" extension cords.
13. Always connect extension cords to a fused line or one protected by a circuit breaker.
14. Disconnect the lawn edger when not in use, prior to cleaning, or when removing or replacing the blade.
15. Do not operate the lawn edger when bare footed or wearing open sandals.
16. Do not use the electric lawn edger in damp or wet locations.
17. Do not use the lawn edger in the rain.
18. When the lawn edger is not in use, store the lawn edger in a dry locked location, away from children.
19. Do not use the lawn edger for any job except for which it is intended.
20. Follow all cleaning and lubrication instructions as outlined in the operator's manual.

## SAFETY RULES WITH POWER TOOLS

### LAWN MOWERS

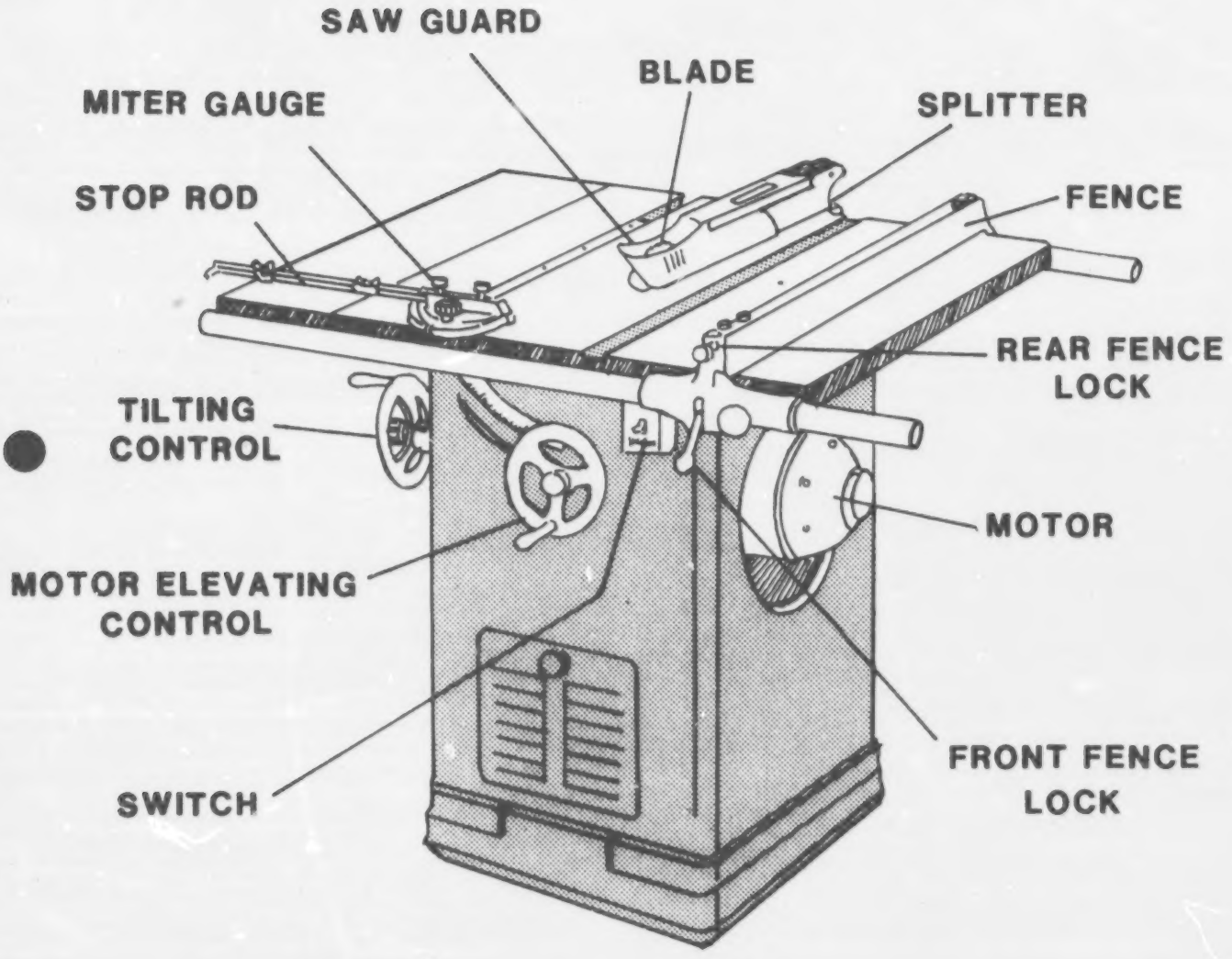
1. Avoid dangerous environment. Do not use the electric lawnmower in damp or wet locations.
2. Keep children away. All visitors should be kept a safe distance from the mowing area.
3. Store idle tools indoors. When not in use, the electric lawn mower should be stored indoors in a dry, high or locked place and out of reach of children.
4. Do not force the tool. The electric lawn mower will do a better job and do it safer at the rate for which it was designed.
5. Dress properly. Do not wear loose clothing or jewelry. They can be caught in moving parts. Shoes must be worn at all times.
6. Never drag the electric mower by the electrical cord or yank it to disconnect it from the receptacle. Keep the cord from heat, oil, and sharp edges.
7. To prevent a shock hazard use only a drop cord suitable for outdoor use.
8. Do not use the electric lawn mower while it is raining.
9. Keep the proper footing and balance at all time. Do not over-reach.
10. Keep the cutting edges sharp and clean for the best and safest performance.
11. Disconnect the electric lawn mower from the power source when not in use, before servicing, and when changing blades.
12. To avoid accidental starting do not carry the lawn mower while it is plugged in and with your finger on the switch.
13. Keep all guards in place and in good condition at all times.
14. Keep hands and feet away from the cutting area.
15. The lawn should always be carefully examined and cleared of all objects prior to each mowing.
16. Never operate the electric mower in a gaseous or explosive atmosphere. Motors in electric lawn mowers spark and these sparks might ignite fumes.
17. Safety glasses should be worn whenever you are operating a lawn mower.
18. Mow across the face of slopes, never up and down. Exercise extreme caution when changing direction on slopes. Do not mow excessively steep slopes.

## SAFETY RULES WITH POWER TOOLS

### HEDGE TRIMMERS

1. Read the owner's manual before you operate a shrub and hedge trimmer.
2. Do not wear loose clothing. Wear non-skid foot wear and safety glasses when operating a hedge trimmer.
3. Keep your hands away from the blades. Keep both hands on the handles when the power is on.
4. Do not feed twigs into the blades or reach over the blade to clean up cuttings while the blades are in operation.
5. Never grasp the blades when picking up the tool. Caution should be watched as the blades continue after the power has been turned off.
6. Do not use the trimmer in rain, on moist plants, or while standing in wet locations.
7. Use only extension cords marked "suitable for use with outdoor appliance."
8. Never carry the hedge trimmer by the cord.
9. Do not yank the cord to disconnect it from the electrical outlet.
10. Keep the cord away from heat, oil, or sharp edges.
11. Do not permit children to come in contact with the trimmer or the extension cord.
12. Use the hedge trimmer only for the specific tasks for which it was designed.
13. Do not carry the tool with your finger on the trigger switch.
14. Do not leave the switch locked on when the tool is not in operation.
15. Disconnect the trimmer from its power supply when the hedge trimmer is not in use, before servicing, and for cleaning.
16. When the hedge trimmer is not in use store it in a dry and locked location.
17. Before using the hedge trimmer inspect it each time for damaged cords or dull blades.
18. If a guide line is used to trim your hedge, make sure this guide line can be easily cut by the trimmer if it becomes entangled in the blades.

# TABLE CIRCULAR SAW



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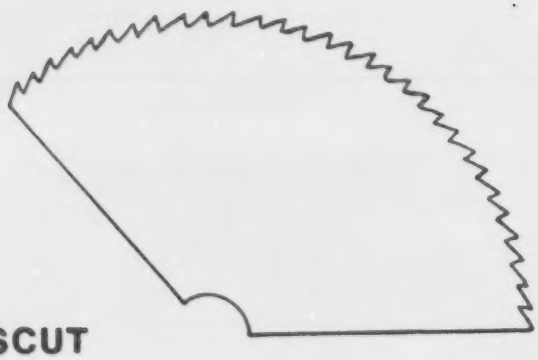

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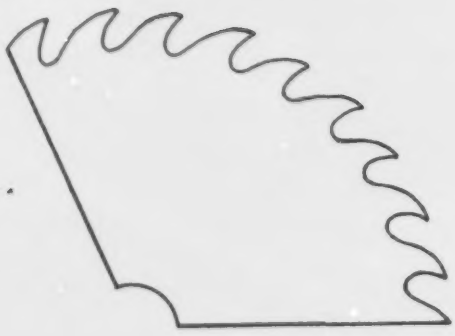

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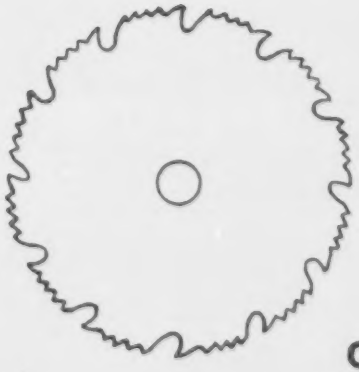
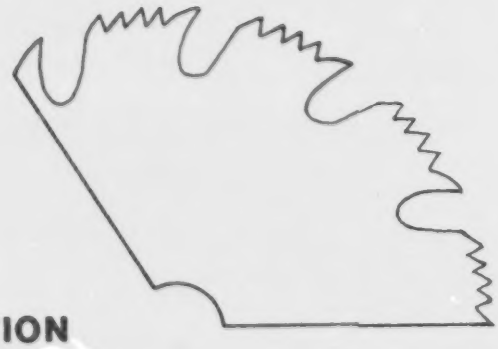
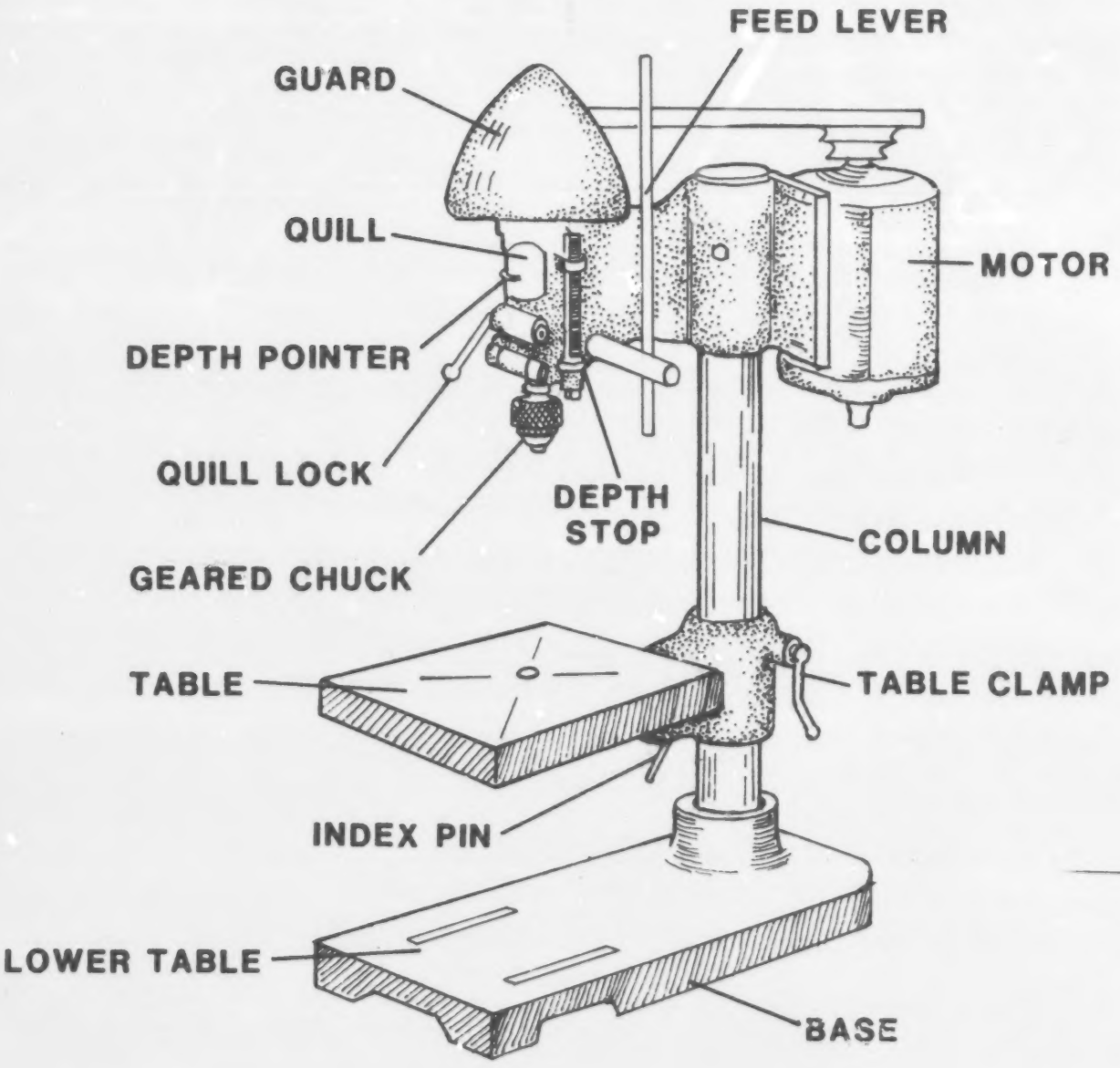




**COMBINATION**

# BENCH MODEL DRILL PRESS



## DISCUSSION GUIDE FOR TRANSPARENCIES

## USING SELECTED POWER TOOLS

I. Transparency: **Table Circular Saw**

A. The table saw is used for many types of straight-edged cuts such as crosscutting, ripping, chamfering, beveling, dadoing, mitering, and rabbeting.

B. Table saws are classified as:

1. Tilting arbor saw – blade and arbor tilt. This is most commonly used in agriculture shops.

2. Tilting table saw – table tilts for sawing angles. This type generally costs less than the tilting arbor saw.

C. Table saws are sized by the maximum diameter blade that will fit on the saw.

D. Major parts of the table circular saw.

1. Blade – determines the size of the circular saw. An 8 inch blade can square cut 2½ inches deep and 1 3/4 inches deep when angled at 45 degrees.

2. Saw guard – safety shield which surrounds the blade. Floats on top of work being cut and has anti-kickback fingers for operator protection.

3. Splitter – keeps cut boards apart and prevents binding of saw blade.

4. Fence – used for ripping lumber. It is adjustable and should be removed from the table when using the miter gauge.

5. Rear and front fence locks – used to secure and square the ripping fence.

6. Motor – generally uses three belts for driving the blade. A commonly used motor would be a 240 volt, 1 H.P. with a 3450 RPM capacitor-start with a built-in overload protector.

7. Switch – controls power to the motor. The switch should be operated only by the operator and not a by-stander or assistant.

8. Motor elevating control – used to raise and lower the saw blade.

9. Tilting control – tilts the blade for cutting angles from 90 to 45 degrees. The blade only tilts in one direction.

10. Stop rod – attaches to the miter gauge and allows stock to be cut to determined lengths.

11. Miter gauge – used for pushing and guiding stock when making crosscuts. It is adjustable in both directions to enable crosscutting from 90 to 45 degrees.

II. Transparency: **Table Saw Blades**

A. Crosscut – used to cut across the grain. The teeth are shaped like a crosscut hand saw. The teeth are smaller than those on the rip blade. The blade tends to get hot if used for ripping.

B. Rip – used to rip lumber. The teeth are shaped like those on a hand-rip saw. It is not suitable for crosscutting as it leaves a very rough finish.

C. Combination – used for both crosscutting and ripping lumber. The teeth are slightly smaller than those on the rip blade and the back of the teeth are beveled. A series of raker teeth are used on the blade which are preceded by a deep groove. The blade produces a smooth cut when crosscutting and ripping.

III. Transparency: **Bench Model Drill Press**

A. There are two general types of drill presses –

1. bench press
2. floor press

B. The primary function is drilling holes; however, with proper attachments the press can be used for sanding, buffing, polishing, routing, shaping, grinding and cutting mortises and rabbets.

C. Common sizes of drill presses are 11 inch, 15 inch, and 17 inch. The size is determined by the distance from the column to the center of the drill chuck.

D. Speeds can vary from 400 to 8500 RPM and are changed by the belt-pulley ratio. Slower speeds are used for drilling metal and faster speeds are used for drilling wood.

E. Parts of the drill press:

1. Feed lever: moves the quill and spindle up and down for drilling. Generally, a spring keeps the quill in its highest position when not in use.
2. Motor – Can be either 120 or 240 volt with 1/3 to 1/2 H.P.
3. Column – Provides support for the head and table.
4. Table clamp – fastens the table to the column. This allows the table to be adjusted up and down and sideways.
5. Base – supports the drill press–some are mounted on benches and some rest on the floor.
6. Lower table – part of the base and serves the same purpose as the movable table when drilling large stock.
7. Index pin – device used to tilt the table for drilling at angles.
8. Table – adjustable support for securing stock for drilling or for other work.
9. Geared chuck – used to attach twist drills and augers to the press. Generally opens to a maximum of 1/2 inch.

10. Depth stop – used to drill holes to a predetermined depth.
11. Quill lock – locks the quill in various depth positions.
12. Depth pointer – indicates depth of hole.
13. Quill – the sleeve that supports the revolving spindle in a vertical position.
14. Guard – protective cover over the pulleys and belt.

## SUGGESTIONS TO THE TEACHER REGARDING STUDENT TESTS ON "SAFE PRACTICES IN THE VOCATIONAL AGRICULTURE SHOP"

1. These tests have been prepared for individual power tools or areas of instruction with each test on a single sheet.

2. Most of the test questions are TRUE–FALSE types. Space has been left between questions for students to explain why the statement is true or false. It may be particularly desirable to explain why a question was marked true or false, thus re-emphasizing correct procedure.

3. A set of correct answers to the test questions is not provided. The correct answers to certain questions depend upon the safety standards adopted by individual teachers.

4. Some teachers may wish to have the students sign the attached statements of safety training and keep them on file.

5. Permission to duplicate any of this material is freely granted. Credit for the material used in this unit is due to many individual teachers. Original drafts were submitted by A. W. Schmidt, D. J. Witt, Loren Mills, and Charles Pearson, Teachers of Vocational Agriculture in Illinois.

Name_____

Student Test Date_____

on

Circular Saws (Tilting Arbor and Radial Arm)

_____ 1. To make accurate cuts with a circular saw, it is necessary to remove the guard.

_____ 2. The operator should always use the miter gauge or the ripping fence and not saw freehand.

_____ 3. The blade should project as far as possible through the work being cut in order to lessen the danger of kickback.

_____ 4. A push stick should always be used by the person helping you rip long narrow boards on the circular saw.

_____ 5. It is safer to remove the ripping fence from the saw (entirely) when cross-cutting is being done.

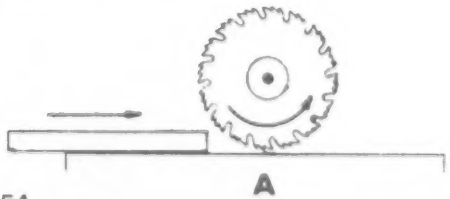
_____ 6. Scraps should not be removed from the area near the saw blade with the fingers until the saw has come to a dead stop.

_____ 7. It is not a safe practice to stop the blade from coasting with a piece of scrap lumber after the motor had been turned off.

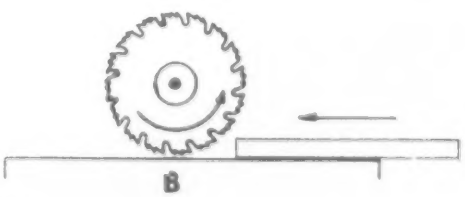
_____ 8. A helper used in ripping long boards should support and guide the board being cut.

_____ 9. You should stand directly in line with the blade when ripping so you can see to follow the line on the work accurately.

_____ 10. Which of the following is correct direction for ripping with a radial arm saw?



A



B

Name_____

Date_____

Student Test

on

Power Grinders

_____ 1. Always use a face shield or goggles when operating a grinder.

_____ 2. Tool rests should never be set as close as 1/8 inch from the wheel because materials are likely to be caught between the rest and the wheel.

_____ 3. When grinding, you should stand directly in front of the wheel so you can have better control over the piece you are grinding.

_____ 4. Keep fingers clear of the wheel when grinding.

_____ 5. After a new wheel has been installed, you should stand to one side, turn it on, and let it run for at least a minute before starting to grind.

_____ 6. Grinding on the flat side of the wheel is permissable when the curved surface is out of shape.

_____ 7. You should wash your hands thoroughly before touching your face or eyes after using a grinder.

_____ 8. Start the grinder and then adjust the tool rest so that it is slightly above the center of the wheel.

_____ 9. You are responsible for the safety of others nearby when you are using a portable grinder.

_____ 10. If anything seems wrong with a grinder, turn it off, and call your instructor.

Name_____

Date_____

Student Test

on

Drill Press and Portable Drills

_____ 1. When using the drill press, clamp small work in a vise or clamp it to the drill press table.

_____ 2. When drilling, remove the shavings from the work with a brush, not your hand.

_____ 3. You should increase the pressure on the drill slightly just as it starts to break through a piece of steel in order to cut a clean hole.

_____ 4. Keep a light film of oil on the floor around the drill press so that chips will not stick to it.

_____ 5. Be sure the switch is "off" when making adjustments on the drill press.

_____ 6. Do not wear loose, floppy clothing when operating a drill press.

_____ 7. The chuck key should always be left in the chuck after using a drill press so it won't get lost.

_____ 8. Do not use a 1/2 inch portable electric drill in an "off balance" position.

_____ 9. Never hold a piece of steel being drilled in one hand and a portable drill in the other.

_____ 10. Always lock the switch "on" when a portable drill is held in your hands.

Name_____

Date_____

Student Test

on

Portable Electric Saw

_____ 1. When using a portable electric saw, use one hand to operate the saw and the other to hold the board securely.

_____ 2. It is not enough to just turn off the portable saw when you wish to change blades, lubricate, or make adjustments.

_____ 3. When you use a portable electric saw for cross-cutting, start the motor with the saw teeth against the wood to prevent kickbacks.

_____ 4. The telescoping guard must be held out of the way when starting a pocket cut.

_____ 5. It is not necessary to ground the frame of a portable electric saw, if the operator is well grounded.

_____ 6. The portable circular saw is equipped with adjustments which may be made while the saw is running.

_____ 7. When finishing a cut, you may safely reach around to catch the board to prevent it from falling down and splintering.

_____ 8. Dull blades cut slower but are safer to use since they would not cut the operator so severely if an accident occurred.

_____ 9. It is good practice to check the blade guard to see that it works freely and springs back promptly before using a portable electric saw.

_____ 10. Never lay a portable saw down until you have turned it off and the blade has stopped turning.

Name_____

Date_____

Student Test

on

The Band Saw

_____ 1. Before using the band saw, always check to see that the blade is centered on the wheels by switching the motor on and off several times.

_____ 2. It is safest to keep both hands on the same side of the blade when operating the band saw.

_____ 3. Use a push stick when your fingers might otherwise come closer than 2 inches to the band saw blade.

_____ 4. It is safest to back a band saw blade out of a blind cut while it is running at full speed.

_____ 5. Narrow blades are best for cutting sharp curves.

_____ 6. It is considered a safe practice to follow a line when sawing with the band saw.

_____ 7. The band saw may be checked for trueness and free blade movement by turning the saw a few revolutions by hand before starting.

_____ 8. Operating a saw with the blade caked with dust, resin, or gum substances may cause breakage.

_____ 9. Blade guards should be removed only when changing band saw blades.

_____ 10. The upper blade guide support should be adjusted to clear the work by (A) no more than; (B) at least; one-half inch.

Name_____

Date_____

Student Test

on

Reciprocating and Sabre Saws

_____ 1. In operating the sabre saw, it is necessary to apply considerable force to move it through the wood.

_____ 2. Check the saw often for loose screws and parts.

_____ 3. Always disconnect the cord when repairing or adjusting the saw or changing blades.

_____ 4. In making a cut with the sabre saw, hold the stock piece firmly in one hand and the saw in the other hand.

_____ 5. When cutting metal with the reciprocating saw, fasten the metal securely in a vise before starting to saw it.

_____ 6. Use the high speed for cutting wood and the low speed for cutting metals.

_____ 7. It is best to use the lock switch while operating the reciprocating saw.

_____ 8. The saw may be held at any angle when sawing except when nearing a corner.

_____ 9. Be sure to keep the saw shoe against the work when sawing.

_____ 10. If the saw has a tendency to bounce, change to a blade having larger teeth.

Name_____

Date_____

Student Test

on

Electric Sanders

_____ 1. Portable disk sanders may be equipped for sanding masonry.

_____ 2. If the disk sander turns clockwise, you should hold the piece being sanded against the right-hand half of the disk.

_____ 3. It is safe to sand pieces that are too small to be run over the jointer safely.

_____ 4. After the disk sander is turned off, you should either stand in front of it until it comes to a dead stop or jam a piece of lumber up against the disk to stop it.

_____ 5. You should empty the dust collector on a portable belt sander each time the sander is used, even if it is only half full.

_____ 6. Plug in a portable sander and then check to be sure the switch is turned off.

_____ 7. It is safer to hold small pieces with one hand and the sander with the other than to hold small pieces in a vise and take a chance on sanding the vise.

_____ 8. Always disconnect the sander from the power before changing the abrasive sheet.

_____ 9. It is all right to lay a sander down while it is still running if you lay it on its side.

_____ 10. Stop the sander before making any adjustments.

Name_____

Date_____

Student Test
on
Soil Shredders

_____ 1. Operate the shredder on a firm level area to prevent tipping.

_____ 2. Stand away from the discharge area when the machine is running.

_____ 3. Stand directly in front of the hopper when feeding in the material.

_____ 4. Wear safety goggles at all times when operating the soil shredder.

_____ 5. Always wear gloves when operating the soil shredding machine.

_____ 6. The machine operator should wear loose fitting clothes when operating the soil shredder.

_____ 7. Never put your hands down into the hopper or discharge opening when the machine is running or when it is plugged into the electrical outlet.

_____ 8. A soil shredder will grind, shred or pulverize all organic material.

_____ 9. The shredder will pulverize dry material more easily than moist material.

_____10. If too much material gets into the shredder, press back on the stone ejector lever with your foot.

_____11. Small stones will normally be pulverized when the shredder discharge door is shut.

_____12. You may move a shredder from one area in the greenhouse to another safely without turning off the motor.

_____13. Shredders powered with gasoline may be refilled while the engine is running.

Name_____

Date_____

Student Test

on

Electric Weed Trimmers

_____ 1. The weed trimmer is designed to cut weeds over 8" tall.

_____ 2. Cut from left to right whenever possible for maximum cutting power.

_____ 3. The weed trimmer should be slightly tilted when trimming weeds.

_____ 4. One can safely trim weeds with an electric trimmer when the weeds are wet.

_____ 5. Guards are needed on the electric weed trimmer.

_____ 6. When moving from one area of the lawn to another, leave the trimmer plugged in.

_____ 7. Never trim weeds with an electric trimmer when it is raining.

_____ 8. Any extension cord is acceptable to use with an electric trimmer.

_____ 9. Trimming weeds while wearing sandals is acceptable.

_____10. Never repair the weed trimmer while it is plugged into the receptacle.

_____11. If the casing is cracked and the machine still runs, it is acceptable to operate the weed trimmer.

Name_____

Date_____

Student Test

on

Concrete Mixers (Soil Mixer)

_____ 1. The barrel or drum of the soil mixer (concrete mixer) can be locked into three different locations.

_____ 2. Always add water to the amended soil mix before it is placed in the soil mixer.

_____ 3. It is safe to place your hands in the soil mixer when it is in operation.

_____ 4. Soil should be placed into the machine before turning the soil mixer "on".

_____ 5. Keep the barrel rotating, in the down position, in order to dump the soil from the mixer into the wheel barrow.

_____ 6. Adjusting the cotter pin enables the barrel to be shifted into its three possible positions.

_____ 7. Never reach across the front of the mixer when turning it off or on.

_____ 8. It is recommended that the mixer be filled with additional materials while the barrel is rotating, assuming you are using a shovel.

_____ 9. When cleaning the mixer, keep the barrel rotating and spray water in the barrel to remove any debris.

_____10. For proper adjustment of the belt, it is recommended to keep the machine running while adjustments are made.

Name_____

Date_____

Student Test
on
Rotary Tillers

_____ 1. The clutch should be in neutral when the machine is being started.

_____ 2. Never clean the rotary tiller when the machine is running.

_____ 3. Never change the blade when the rotary tiller is running.

_____ 4. When the new machine is delivered, oil is included in the tiller drive box.

_____ 5. It is not dangerous to pull the engine starter cord while the engine is running.

_____ 6. Full throttle is the best speed for tilling new soil.

_____ 7. The cutting depth of the tiller is controlled by the height of the drag bar.

_____ 8. For a deep cut increase the downward pressure on the handles.

_____ 9. The tiller should be left running if you are moving the tiller in a truck.

_____10. The air filter on the tiller should be checked no more than once every five hours.

_____11. Rotary tiller oil should not be changed.

Name_____

Date_____

Student Test

on

Soil Sterilizers

_____ 1. When using a soil sterilizer, water should be added to the soil media to aid in the speed of pasteurization.

_____ 2. When pasteurizing soil, remove the soil media immediately after the automatic switch turns the sterilizer "off".

_____ 3. Soil media can be left in the pasteurizer for several days after pasteurization.

_____ 4. The electric soil sterilizer should be unplugged when not in use.

_____ 5. Be sure to switch "off" the sterilizer when filling the soil sterilizer.

_____ 6. Never operate the soil sterilizer while standing in mud or water.

_____ 7. An electric soil sterilizer should be used only on a flat, even surface.

_____ 8. The lid of a soil sterilizer should be in place before the soil sterilizer is switched "on".

_____ 9. Never remove the soil sterilizer lid while soil is being pasteurized and the temperature light is still "on".

_____10. Allow the soil media in an electric sterilizer to cool 15 minutes before removing the soil media.

Name_____

Date_____

Student Test

on

Chain Saws

_____ 1. It is not necessary to read the owner's manual before operating a chain saw.

_____ 2. It is not necessary to have a guide bar located on the power chain saw.

_____ 3. All chain saws use the same fuel mixture.

_____ 4. Most chain saws are designed to use the right index finger to operate the throttle.

_____ 5. Eye protection is a must when operating any chain saw.

_____ 6. Stop the engine and do not smoke while refueling your chain saw.

_____ 7. Shut off your chain saw while carrying it from one tree to another.

_____ 8. A chain saw should always be carried with the guide bar pointed to the rear.

_____ 9. Two people are needed when operating a chain saw.

_____10. A chain saw should not be held higher than the operator's waist.

_____11. Trim the limbs from a fallen tree while standing on the opposite side of the trunk.

_____12. A second person is needed to hold the ladder while a person is operating a chain saw while on a ladder.

Name_____

Date_____

Student Test

on

Electric Lawn Edgers

_____ 1. Safety goggles must be worn when using an electric lawn edger.

_____ 2. Guards must always be in place when operating an electric lawn edger.

_____ 3. Long pants must be worn when operating an electric lawn edger.

_____ 4. Never yank the cord from the receptacle.

_____ 5. Never operate the electric lawn edger when bare-footed or when wearing open sandals.

_____ 6. Never operate the electric lawn edger in a damp or wet location.

_____ 7. Never use the electric lawn edger in the rain.

_____ 8. Never repair the electric lawn edger with the power supply connected.

_____ 9. Make sure that other persons are at least 100 feet away from the electrical edger while it is in operation.

_____ 10. Always stand to the left side of the electric lawn edger.

Name_____

Date_____

Student Test

on

Lawn Mowers

_____ 1. Electric mowers can be used while the dew is still on the lawn.

_____ 2. When operating "walk behind" mowers, cut across the slopes, never up and down.

_____ 3. Shut off the motor, disconnect the spark plug, and wait until moving parts have stopped before attempting maintenance.

_____ 4. On power mowers, do not remove the grass catcher bag before the mower has completely stopped.

_____ 5. Never remove a safety device or guard on the lawn mower.

_____ 6. Always refuel the gasoline engine mower outdoor.

_____ 7. Always refuel only when the motor has stopped.

_____ 8. Never operate a lawn mower in bare feet or open-faced sandals.

_____ 9. Children under the age of ten can safely operate a lawn mower.

_____10. Non-grounded extension cords can be used with electric lawn mowers.

_____11. Safety glasses should be used when operating a lawn mower.

_____12. Operate a gasoline engine lawn mower at the slowest speed possible to obtain a satisfactory cutting job.

_____13. Never attempt to adjust the cutting height without first stopping the engine.

_____14. Always set the four wheels of the lawn mower at the same height.

_____15. All lawn mowers are equipped with a shear pin on the rotating blades.

_____16. Always read the owner's manual before operating any lawn mower.

Name_____

Date_____

Student Test

on

Hedge Trimmers

_____ 1. The owner's manual must be read thoroughly before operating the hedge trimmer.

_____ 2. Both hands should be on the handles when operating the hedge trimmer.

_____ 3. Twigs should not be hand-fed into the hedge trimmer.

_____ 4. The hedge trimmer should never be picked up by the blades.

_____ 5. Never use the electric trimmers in the rain.

_____ 6. Children under the age of 10 should not operate a hedge trimmer.

_____ 7. Hedge trimmers should be operated with groups of people.

_____ 8. Always disconnect the hedge trimmer from its power source when it is not being used.

_____ 9. Before using the hedge trimmer, inspect it for a damaged cord and dull blade.

_____10. Hedge trimmer blades must be lubricated for safe use.

_____11. When the hedge trimmer is equipped with a power pack, the tool must be stored in a locked area or out of the reach of children.

## UNIT H: AGRICULTURAL MECHANICS

## PROBLEM AREA: DEVELOPING SAFE WORK HABITS IN AGRICULTURAL MECHANICS

### SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with freshman or beginning students enrolled in an agricultural/horticultural occupations program. The recommended time for teaching this problem area is prior to the student's shop project work. The estimated time for teaching this problem area is 3 to 5 days depending on how much time the teacher wishes to spend on discussion and conducting the suggested exercises. The materials in this problem area were selected and written with the following assumptions:

1. It is important for students to develop and practice a positive safe work attitude.

2. Students need instruction on the procedures to follow regarding first-aid.

Even though a separate problem area on safety has been included in these Core I materials, teachers should not assume that safety should be taught solely as a separate unit. Instruction in safety should be included in all problem areas where applicable and handled as an integral part of the teaching program.

### CREDIT SOURCES:

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The teacher's guide, worksheets, and transparency discussion guide were developed by Paul Benson, Jerry Pepple, and Jim Ethridge, Department of Vocational and Technical Education, University of Illinois. The transparency masters, safety charts and suggested test questions were prepared by Vocational Agriculture Service, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Rural and Metropolitan Core Curriculum Pilot Test Teachers.

## TEACHER'S GUIDE

I. Unit: Agricultural mechanics

II. Problem area: Developing safe work habits in agricultural mechanics

III. Objectives: At the close of this problem area students will:

1. Understand the value of a positive safety attitude.
2. Understand the value and purposes of sound safety practices.
3. Know and practice proper safety procedures inside and outside of the agricultural mechanics laboratory (shop) or greenhouse.
4. Know the proper steps to take regarding accidents and first aid.

IV. Suggested interst approaches:

1. Demonstrate the results of various hazards that may occur in the shop, and greenhouse, for example:
   a. Demonstrate the flammability of human hair by collecting some from each student and igniting it at the front of the class.
   b. Demonstrate the flammability and burning characteristics of various types of clothing, both old and new.
   c. Demonstrate how a piece of metal in a drill press may catch on the bit and start spinning.
   d. Demonstrate cutting a board with a hand saw and fake a cut on the hand by using red dye. Yell out and then ask the class what they should do for first aid.
2. Lead into a discussion of safety practices by asking students if they have been involved in any accidents. Then ask them to describe what happened and also how these accidents could have been avoided.
3. Show color filmstrip that illustrates the results of proper and poor safety procedures.
4. Take the class into the laboratory and ask them to list, or point out, the potential hazards.
5. Ask the students to name as many safe operating procedures as they can and list them on the board.
6. To insure student safety students must demonstrate their knowledge of safety by passing a safety exam before being able to work in the shop.
7. Take the class to a home shop to observe safety procedures and potential hazards.
8. Develop student interest and motivation by asking the following lead questions:
   a. What type of fire extinguishers do you have at home?
   b. Where are the fire extinguishers in the lab?

c. What is a fire blanket made of and how do you use it?

d. How could a dull power tool cause an accident?

e. How could safety glasses protect your eyes in the shop?

f. What are the OSHA safety procedures that are required in a machine shop?

g. Are safety glasses required by law in a school shop?

V. Anticipated problems and concerns of students:

1. Why should I practice good safety procedures?

2. What are good safety procedures?

3. What are the purposes of good safety procedures?

4. Why do I need to dress differently for the lab than for class?

5. Do I need to demonstrate all safety procedures before I will be allowed in the shop?

6. How will knowing safety practices be beneficial outside the shop?

7. Will knowing and following safety procedures count as a part of my grade? How much?

8. Where is the first aid kit and what is in it?

9. Where is the fire extinguisher and how do you use it?

10. What do I do if:

a. I get cut?
b. I get burnt?

11. Do I have to wear safety glasses in the shop? Why?

VI. Suggested learning activities and concerns:

1. Have class read VAS Unit 3022, Section 1, 2, and 3, **Safety in the Agricultural Mechanics Shop**, and record tentative answers to the problems and concerns identified by the class or teacher when first starting problem area.

2. Distribute Worksheet 1, **Safety in the Agricultural Mechanics Shop**, and have students answer questions.

3. Show the following transparencies:

a. Safety Hazards
b. Types of Fire Extinguishers
c. Shop Safety and Hand Tools

4. Distribute Worksheet 2, **Checklist of Shop Hazards**, and have class fill out in shop area.

5. Conduct or have students conduct fire extinguisher demonstration using Job Sheet 1.

6. Show VAS filmstrip, "The Circular Saw and How to Use it Safely," and discuss.

7. Have class read VAS Unit 3044, **A Color Code for Shop Safety.**

8. Distribute Worksheet 3, **Color Code for Shop Safety**, and have class fill out.

9. Have class look at FFA record book on **Safety** and discuss the possibility of a student S.O.E. program on safety.

10. Have students develop and conduct an FFA Chapter Safety Program.

11. Show film on greenhouse fire hazards and flammability of polyethelene and fiber glass.

VII. Application procedures:

1. The main purpose of this problem area is to develop a positive safety attitude and avoid bodily injury.

2. The students should apply all safety procedures learned in the classroom to working in the shop, at their homes, and at their place of employment.

3. Have students develop an S.O.E. safety project and submit records for sectional competition.

4. Have FFA chapter develop and conduct a safety campaign and submit for sectional competition.

VIII. Evaluation:

1. Prepare and administer a pencil and paper test covering safety procedures.

2. Grade worksheets.

3. Prepare and administer laboratory practical examination on safety procedures.

4. Administer VAS Safety Test "Safe Practices in the Vocational Agriculture Shop" (Section on general shop safety).

IX. References and aids:

1. VAS Unit 3022, "Safety in the Agricultural Mechanics Shop."

2. VAS Unit 3044, "A Color Code for Shop Safety."

3. VAS Safety Test, "General Shop Safety" and "Safety Quiz – Horticulture."

4. VAS Filmstrip, "The Circular Saw and How to Use it Safely."

5. VAS Transparencies on General Safety.

6. Student Worksheets 1, 2, and 3 and Teacher's Key.

7. Job Sheet 1, "Safe Use of Fire Extinguishers."

8. VAS Safety Charts

9. Phipps. Lloyd J., Mechanics in Agriculture, The Interstate Printers and Publishers, Inc., Danville, Illinois.

10. National FFA Chapter Safety Award Handbook.

11. Illinois Foundation FFA Record Book on Safety.

## STUDENT WORKSHEET 1

## SAFETY IN THE AGRICULTURAL MECHANICS SHOP

1. Name three ways to dress properly for shop work:

   a. _____

   b. _____

   c. _____

2. List at least one reason why you should:

   a. Keep all edge tools sharp? _____

   _____

   b. Use wrenches of the proper kind? _____

   _____

   c. Use files with handles? _____

   _____

   d. Not use a punch with a mushroomed head? _____

   _____

   e. Adjust the jaws of adjustable wrenches? _____

   _____

   f. Not use a wrench as a hammer? _____

   _____

3. Why should you not use a penny as a substitute for an electrical fuse?

   _____

   _____

4. List one unsafe way to use the following tools:

   a. Pliers _____

   b. Screwdriver _____

   c. Carpenter's hammer _____

5. List five possible hazards while working with electricity in the shop?

a. _____

b. _____

c. _____

d. _____

e. _____

6. What do you think are the most important safety rules for shop work?

a. _____

b. _____

c. _____

d. _____

e. _____

## STUDENT WORKSHEET 2

## CHECKLIST OF SHOP HAZARDS

(To be filled out in shop area)

List and give the location of possible safety hazards in the shop.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

## STUDENT WORKSHEET 3

## COLOR CODE FOR SHOP SAFETY

I. List the purposes of the safety color code as used in agricultural mechanics programs.

a. _____

b. _____

c. _____

d. _____

II. Match the colors used in the safety color code to the proper descriptions.

1. Green
2. Aluminum
3. Yellow
4. Red
5. Blue
6. Orange
7. Ivory

_____ a. Applied to electrical switches, interior surfaces of doors, fuse and electrical power boxes, movable guards and parts, inside of nonmovable guards, traffic lanes, and overhead hazards; used to designate dangerous parts of equipment which may cut, crush shock, or otherwise injure.

_____ b. Applied to operating levers, wheels, handles, and hazardous areas which may cause stumbling, falling or tripping; used to designate caution.

_____ c. Applied to noncritical parts of equipment and machine surfaces, nameplates, and bearing surfaces; used to designate the location of safety and first aid equipment.

_____ d. Applied to tops of tables and work areas to provide contrast with work.

_____ e. Used to identify the location of fire fighting equipment.

_____ f. Applied to tabel edges, vise jaws, and edges of tool rests to reflect light and "show the way".

_____ g. Used as the basic color for designating caution against starting equipment while it is being worked on or against the use of defective equipment.

TEACHER'S KEY
STUDENT WORKSHEET 1

# SAFETY IN THE AGRICULTURAL MECHANICS SHOP

1. Name three ways to dress properly for shop work:

   a. Wear appropriate clothes

   b. Keep hair cut

   c. Wear safety goggles

2. List at least one reason why you should:

   a. Keep all edge tools sharp?

   Dull tools require extra pressure which might result in slippage and injury to the operator

   b. Use wrenches of the proper kind?

   To avoid slippage and reduce possibility of injury to your knuckles.

   c. Use files with handles?

   To reduce possibility of an injury from the sharp tang.

   d. Not use a punch with a mushroomed head?

   Particles may break off and injure the operator.

   e. Adjust the jaws of adjustable wrenches?

   Wrench may slip or break if not adjusted properly.

   f. Not use a wrench as a hammer?

   Wrench may break or chip

3. Why should you not use a penny as a substitute for an electrical fuse?

   It may result in overheated conductors and appliances and could start a fire.

4. List one unsafe way to use the following tools:

   a. Pliers using them as a wrench.

   b. Screwdriver using it as a cutting tool or punch.

   c. Carpenter's hammer using it to strike a punch or chisel.

5. List five possible hazards while working with electricity in the shop?

a. Using tools with damaged cords or faulty plugs.

b. Using tools without a grounding conductor.

c. Overloading extension cords.

d. Handling electrical cords with wet hands.

e. Placing extension cords in doorways.

6. What do you think are the most important safety rules for shop work?

a. Do not engage in horseplay.

b. Wear safety goggles.

c. Avoid "hurry".

d. Dress properly.

e. Unplug tools before cleaning or adjusting.

TEACHER'S KEY
STUDENT WORKSHEET 3

# COLOR CODE FOR SHOP SAFETY

I. List the purposes of the safety color code as used in agricultural mechanics programs.

a. Reduces glare by diffusing light for better vision.

b. Reduces eyestrain, tension and fatigue.

c. Points out critical parts and areas.

d. Provides a more pleasing environment.

II. Match the colors used in the safety color code to the proper descriptions.

1. Green
2. Aluminum
3. Yellow
4. Red
5. Blue
6. Orange
7. Ivory

6 a. Applied to electrical switches, interior surfaces of doors, fuse and electrical power boxes, movable guards and parts, inside of nonmovable guards, traffic lanes, and overhead hazards; used to designate dangerous parts of equipment which may cut, crush shock, or otherwise injure.

3 b. Applied to operating levers, wheels, handles, and hazardous areas which may cause stumbling, falling or tripping; used to designate caution.

1 c. Applied to noncritical parts of equipment and machine surfaces, nameplates, and bearing surfaces; used to designate the location of safety and first aid equipment.

2 d. Applied to tops of tables and work areas to provide contrast with work.

4 e. Used to identify the location of fire fighting equipment.

7 f. Applied to tabel edges, vise jaws, and edges of tool rests to reflect light and "show the way".

5 g. Used as the basic color for designating caution against starting equipment while it is being worked on or against the use of defective equipment.

## JOB SHEET 1

## SAFE USE OF FIRE EXTINGUISHERS

Objectives:

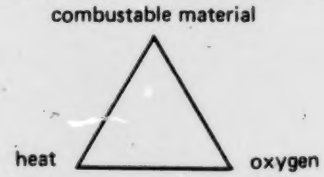
1. To understand how to properly use fire extinguishers.
2. To be able to control wood, oil and gasoline type fires.
3. To be able to recognize fire hazards in a shop and determine methods to eliminate the identified hazard.

Materials:

1. Each type of fire extinguisher available in the shop and/or school.
2. Metal pan of wood scraps.
3. Metal pan with oil (diesel fuel).
4. Metal pan with sawdust or old rags soaked with gasoline.
5. Water hose.
6. Matches.

Procedures:

1. Carefully select the demonstration area, this should be outside the building yet accessible to the students.
2. Read references and instructions on the fire extinguishers before the demonstration and practice the demonstration.
3. Show and explain how the different types of fire extinguishers should be carried and operated when controlling a fire.
4. Explain how fire extinguisher works by use of fire triangle chart.




5. Demonstrate each type of fire extinguisher on each type of fire. Discuss why certain types of fire extinguishers were not effective on some of the fires. Could also demonstrate using only water to control oil or gasoline fires.
6. Have students demonstrate how to use fire extinguishers.

7. Summarize as follows:

   a. Keep calm, sound alarm (use good judgement).
   b. Call Fire Department, give your name, complete location of fire.
   c. Select proper fire extinguisher.
   d. Control base of fire,
      1) windward and base of horizontal fires
      2) base of vertical fires
   e. Do not take chances with your personal safety.

Questions:

1. Which type of fire extinguisher should you use?

   Identify the types of fires controlled by:

   Type "A" extinguisher _____

   _____

   Type "B" extinguisher _____

   _____

   Type "C" extinguisher _____

   _____

2. Why do you not use a soda acid extinguisher on an electrical fire?

   _____

   _____

3. What three things are necessary for a fire? _____

   _____

4. What is the local phone number for:

   a. Fire Department _____

   b. Police Department _____

Observation:

Record the location and type of fire extinguisher in the shop and classroom. Also note location of fire alarms.

Conclusions:

Record the results of the fire extinguishers' demonstrations. Note what happens when each type of extinguisher is used on each fire. Develop a list of approved practices to follow in preventing fires.

# TYPES OF FIRE EXTINGUISHERS

PRESSURIZED WATER

SODA-ACID

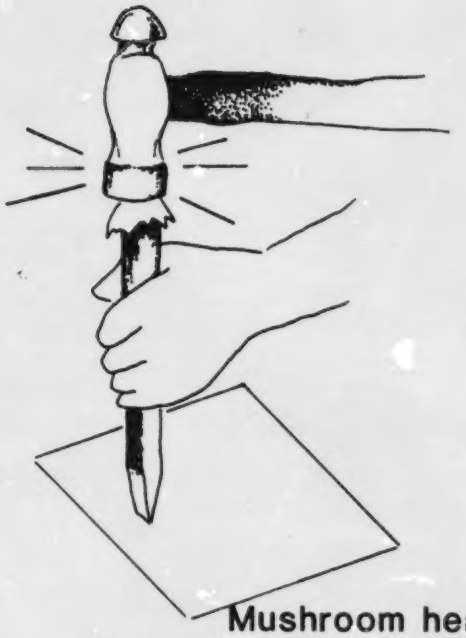
CARBON DIOXIDE

DRY CHEMICAL

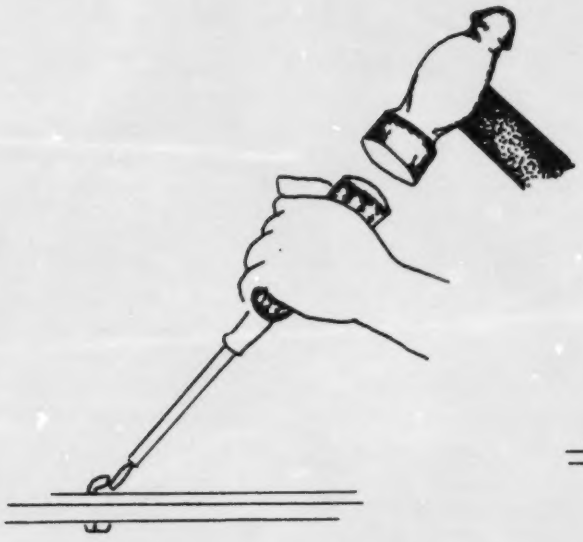
FOAM

# SHOP SAFETY HAND TOOLS

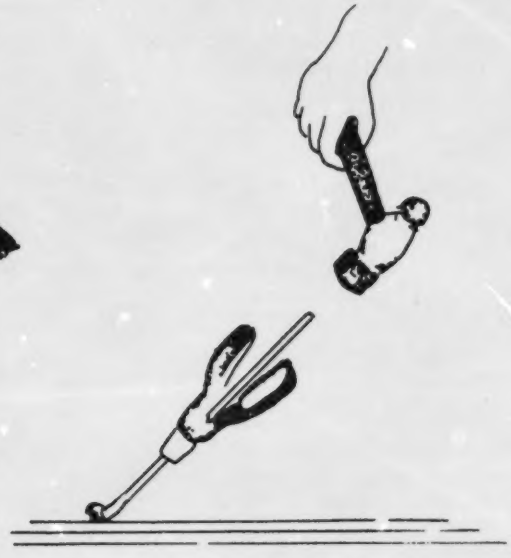
Dull wood chisel slips causing injury



Mushroom head cold chisel--sliver causes injury



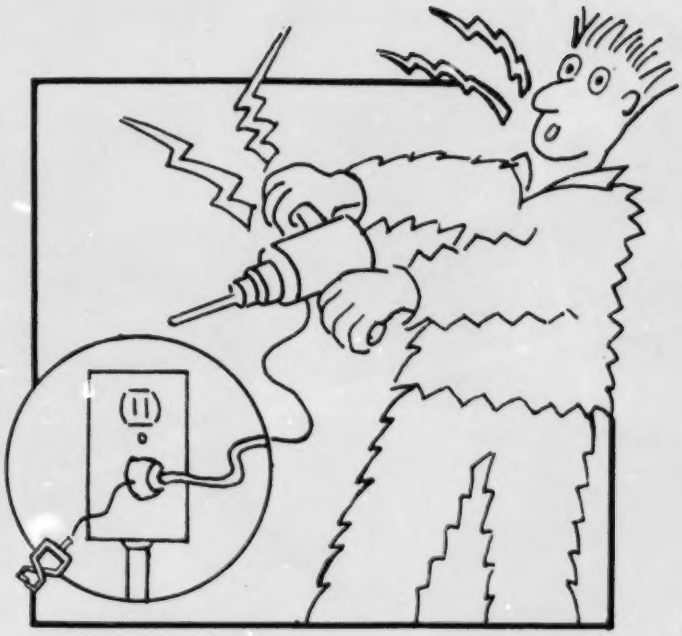
Improper use of hand tool can cause injury



Possible injury to body by improper tool use

# SAFETY HAZARDS

Secure objects to be drilled!



Ground all electrical appliances!

Use a miter gauge when crosscutting

Wear appropriate clothing for the job!

## SUGGESTIONS TO THE TEACHER REGARDING STUDENT TESTS ON "SAFE PRACTICES IN THE VOCATIONAL AGRICULTURE SHOP"

1. These tests have been prepared for individual power tools or areas of instruction with each test on a single sheet.

2. Most of the test questions are TRUE–FALSE types. Space has been left between questions for students to explain why the statement is true or false. It may be particularly desirable to explain why a question was marked true or false, thus re-emphasizing correct procedure.

3. A set of correct answers to the test questions is not provided. The correct answers to certain questions depend upon the safety standards adopted by individual teachers.

4. Some teachers may wish to have the students sign the attached statements of safety training and keep them on file.

5. Permission to duplicate any of this material is freely granted. Credit for the material used in this unit is due to many individual teachers. Original drafts were submitted by A. W. Schmidt, D. J. Witt, Loren Mills, and Charles Pearson, Teachers of Vocational Agriculture in Illinois.

Name_____

Date_____

Student Test

on

General Shop Safety

_____ 1. It is the responsibility of every student to learn to work in a safe manner.

_____ 2. Such items as loose neckties, loose sleeves, and loose aprons must be secured or removed before operating a machine.

_____ 3. When "clean up" time is announced, hurry and get your work finished.

_____ 4. Students should not operate a machine unless the instructor is in the shop.

_____ 5. Students, not using proper safety precautions, should not be permitted to operate the equipment.

_____ 6. Noninterference with others is a good safety rule.

_____ 7. No student, who has had an accident which has caused the flow of blood, should leave the classroom alone.

_____ 8. Do you know the location of the fire extinguishers in your shop? (yes) (no)

_____ 9. Good natured scuffling, pushing, and horseplay in the shop can cause a serious accident.

_____ 10. Any students not operating a machine should stay out of the machine area.

SAFETY QUIZ

HORTICULTURE

Name_____

Date_____

_____ 1. I will only operate machines in the Horticulture Department at _____ that I have been taught how to operate.

_____ 2. When operating a piece of equipment, I will do so in a safe manner so as not to jeopardize the safety of myself or any bystanders.

_____ 3. A machine is not to be left running while unattended.

_____ 4. A machine in need of repair is to be turned off while repair is being done.

_____ 5. All breakdowns or malfunctions in equipment are to be reported to the instructor immediately.

_____ 6. Machines are to be operated only with all safety shields in place.

_____ 7. I realize being a safe operator of equipment is one of the most important skills I can develop.

_____ 8. All machines should be operated at the appropriate speed for the job, never at excessive speeds.

_____ 9. I realize the importance of safety glasses in the operation of certain pieces of equipment.

_____10. Proper clothing and shoes are very important for safe operation of equipment.

_____11. I will only operate a piece of equipment at _____ with the consent of the instructor.

## UNIT H: AGRICULTURAL MECHANICS

## PROBLEM AREA: DEVELOPING BASIC CARPENTRY SKILLS

### SUGGESTIONS TO THE TEACHER:

This problem area is designed for use with freshman or beginning students enrolled in an agricultural/horticultural occupations program. The recommended time for teaching this problem area is during the early part of spring semester. The estimated time for teaching this problem area is 10 to 15 days depending on how much time the teacher wishes to spend on discussion and conducting the suggested exercises. The materials in this problem area were selected and written with the following assumptions:

1. It is important for students to plan and construct a project to develop their shop skills.

2. Students need to be involved in the "doing" phase of instruction to maximize retention of material learned.

The instructor is reminded that this problem area can be used in either a rural or urban setting. The items in this problem area are for reference or modification as the teacher adapts this material to his/her local situation.

### CREDIT SOURCES:

These materials were developed through a funding agreement, R-33-21-D-1542-388 with the Illinois State Board of Education, Department of Adult, Vocational and Technical Education, Research and Development Section, 100 North First Street, Springfield, Illinois 62777. Opinions expressed in these materials do not reflect, nor should they be construed as policy or opinion of the State Board of Education or its staff.

The teacher's guide, suggested content outline and suggested test questions were developed by Paul Hemp, Department of Vocational and Technical Education, University of Illinois. The student worksheets and suggested project plans were prepared by Vocational Agriculture Service, University of Illinois. Suggestions and guidance in the development of these materials were provided by the Rural and Metropolitan Core Curriculum Pilot Test Teachers.

## TEACHER'S GUIDE

I. Unit: Agricultural mechanics

II. Problem area: Developing basic carpentry skills

III. Objectives: At the close of this problem area, students will:

1. Be able to identify and classify the following as softwood or hardwood: white pine, fir, cedar, poplar, oak, yellow pine, ash, elm, maple and hickory.

2. Be able to list the characteristics and common uses of select, common and dimension lumber.

3. Be able to identify with 90% accuracy the following hardware items:

| | | | |
|---|---|---|---|
| a. | common nail | g. | stove bolts |
| b. | finishing nail | h. | machine bolts |
| c. | box nails | i. | carriage bolts |
| d. | roofing nails | j. | toggle bolts |
| e. | lag screws | k. | strap hinge |
| f. | flat-headed wood screw | l. | T hinge |

4. Be able to sketch a project showing the top, side and end view.

5. Be able to read a blueprint and calculate a bill of materials from the blueprint drawing.

6. Be able to calculate board feet and running feet from a bill of materials supplied by the teacher.

7. Be able to perform the following skills to the satisfaction of the instructor:

a. Measuring and marking a ten feet length of board within 1/8"
b. Squaring a board
c. Sawing a board
d. Smoothing a rough cut on a board
e. Joining two boards with nails
f. Boring a hole in a 2" board

8. Be able to plan and construct a wood project which meets the following specifications:

a. Plan meets the approval of the teacher and parent.
b. Bill of materials is judged to be 95% accurate by the teacher.
c. Cutting list is judged to be 95% accurate by the teacher.
d. Finished project is square, level and free of splits and hammer marks.

IV. Suggested interest approaches:

1. Obtain sample pieces of wood from a lumber yard.
Hold samples up to the class and ask them to identify the wood.

2. Ask class to identify a variety of nails and other hardware

3. Explain to the class that they will be building a carpentry project and that before the project is started, basic information and skills must be learned.

4. Ask class to name the trees that grow in the community. Ask them to name the trees that are used for lumber.

5. Conduct a discussion of past experiences of students to see how many class members have done carpentry work.

6. Show class examples of wood projects constructed by previous classes.

V. Anticipated problems and concerns of students:

1. What kind of lumber should I use for my project?

2. What kinds of lumber are available and what are they used for?

3. What is heartwood? sapwood?

4. What causes a knot in lumber?

5. What are the lumber grades and what are the characteristics of each grade?

6. Why does lumber warp? How can this be prevented?

7. What factors should be considered in selecting lumber?

8. What are the different types of nails, screws and bolts and how are they used?

9. What are the various types of hinges and fasteners and how are they used?

10. When should glue be used?

11. How can I drive a nail properly?

12. What do I need to know about a blueprint?

13. What is a bill of material? a cutting list?

14. How is board feet and running feet calculated?

15. How are drawings made to scale?

16. What are isometric, oblique and orthographic projections?

17. What steps are involved in performing basic carpentry skills?

VI. Suggested learning activities and experiences:

1. Select problems and concerns related to VAS Unit 3052 and handle them first. This unit covers nails, wood screws, bolts, hinges, fasteners and glue.

2. Conduct an identification contest to provide class with practice and identifying hardware.

3. Have class make charts showing various types of nails and other hardware.

4. Select problems and concerns related to lumber and wood. Use information included in Chapter 8 of **Mechanics in Agriculture** to answer questions.

5. Take class on a field trip to a lumber yard to see how lumber is graded, stored and sold.

6. Assign students problems to work on board feet and running feet.

7. Obtain a cross section of an old tree trunk and use it to point out the following to the class:

   a. Type of tree or wood
   b. Sapwood
   c. Heartwood
   d. Annual rings

8. Have students select a project to build in the shop. Obtain parental approval for all project plans.

9. Have students sketch project plan, calculate a bill of materials and cutting list or have them use one of the sample plans included with this packet.

10. Have students read VAS Unit 3051 and use worksheets or reproduce them for student use.

11. Have students read VAS Unit 3052 on Selecting Fasteners and Hardware.

12. Demonstrate or have students demonstrate the basic carpentry skills such as squaring a board, boring a hole, etc.

13. After projects are completed, have class evaluate each project in terms of criteria listed in VAS Unit 3051.

VII. Application procedures:

1. Encourage students to build additional projects for their S.O.E.P. or for home use.

VIII. Evaluation:

1. Prepare and administer a pencil and paper test using the sample questions included with this problem area.

2. Conduct identification contests on wood samples, hardware and fasteners.

3. Grade each finished project and explain to students why the grade was given.

4. Have class select the best "carpenter" in the class based on safety practices followed, use of time, use of tools, cleanup procedures and carpentry skills.

IX. References and aids:

1. VAS Unit 3051, "Planning a Woodworking Project"

2. VAS Unit 3052, "Selecting Fasteners and Hardware"

3. **Mechanics in Agriculture**, by Lloyd Phipps, The Interstate Printers & Publishers, Danville, IL.

4. Teacher's guide and suggested test questions.

5. Sample plans

## SUGGESTED CONTENT OUTLINE

## DEVELOPING BASIC CARPENTRY SKILLS

I. Selecting Lumber

- A. Classes of lumber
- B. Types of wood
- C. Grading lumber
- D. Selecting and buying lumber

II. Selecting and Using Hardware and Glue

- A. Identifying and use nails
- B. Identifying and using wood screws
- C. Identifying and using bolts
- D. Identifying and using other hardware
- E. Selecting and using glue

III. Making Sketches and Reading Blueprints

- A. Importance of using a sketch or plan
- B. Sketching
- C. Reading blueprints

IV. Computing a Bill of Materials

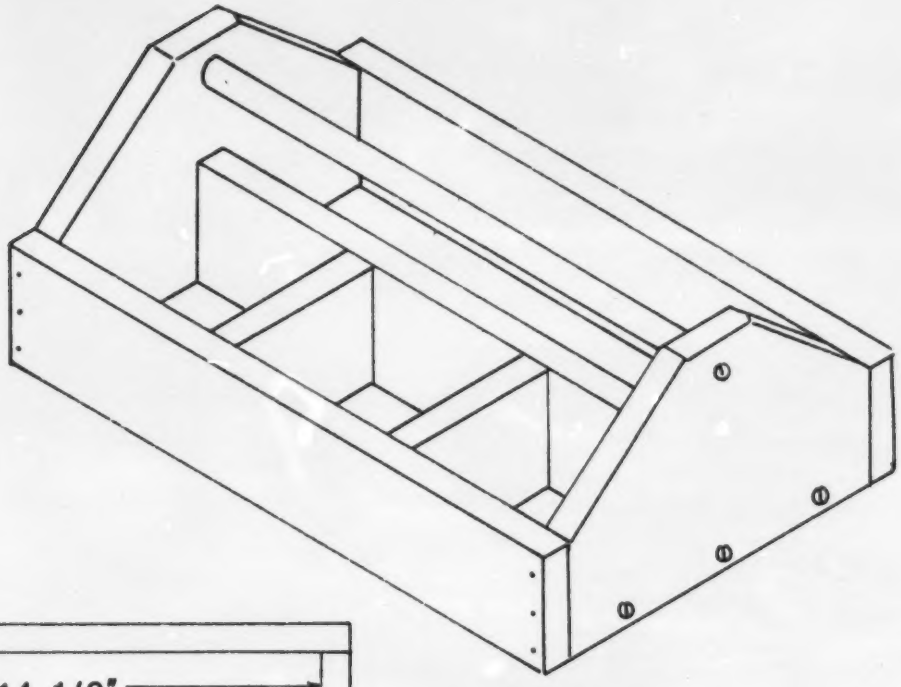
- A. Defining a bill of materials
- B. Measuring lumber—board feet and running feet
- C. Writing out a bill of materials

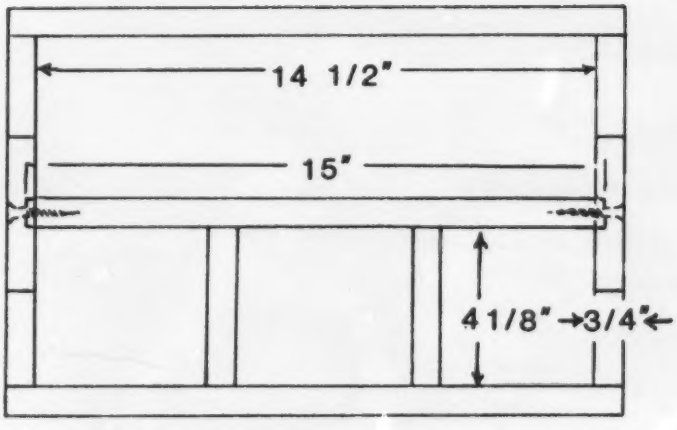
V. Developing Basic Woodworking Skills

- A. Measuring and marking boards
- B. Squaring a board
- C. Sawing
- D. Shaping and smoothing boards
- E. Joining and fastening boards
- F Boring holes

VI. Constructing a Carpentry Project

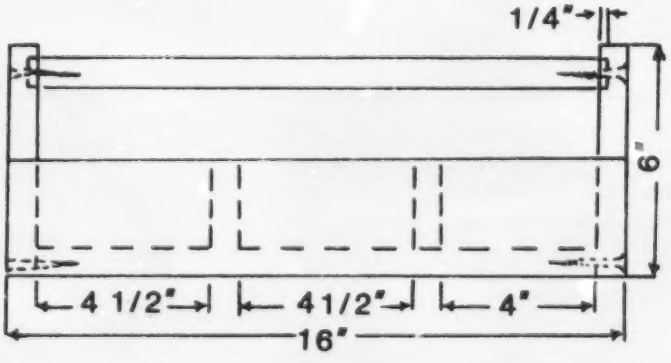
- A. Deciding what to build
- B. Procedures to follow
- C. Evaluating the finished project



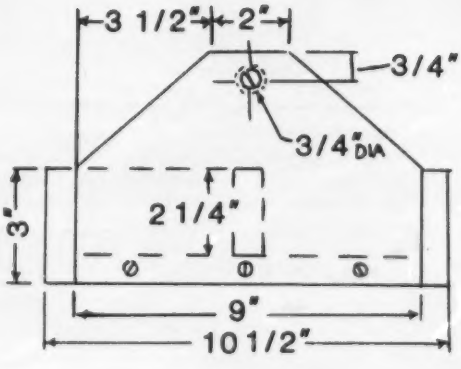



TOP VIEW

# NAIL BOX

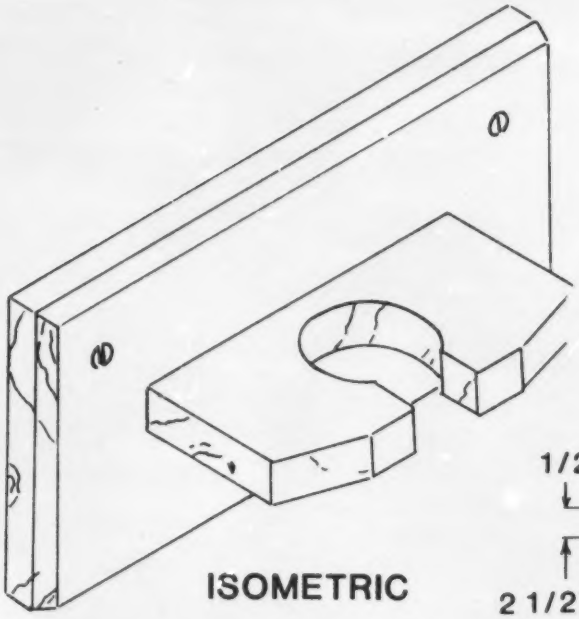



SIDE VIEW

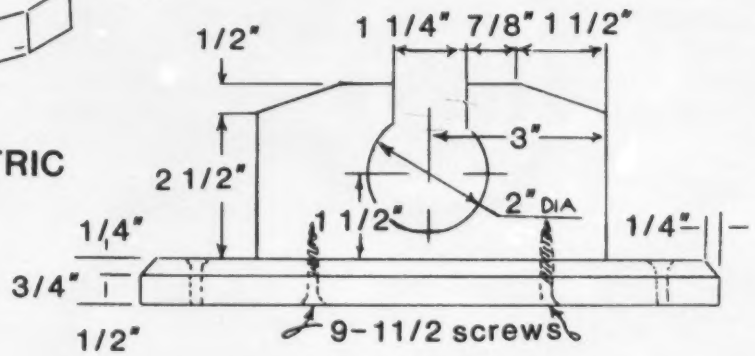



END VIEW

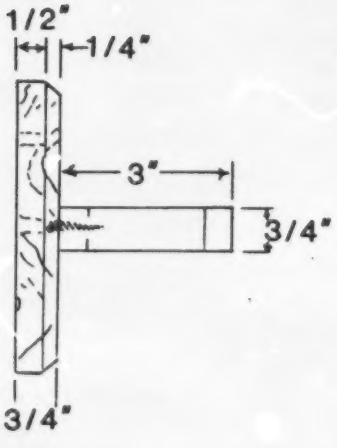
# BROOM HOLDER



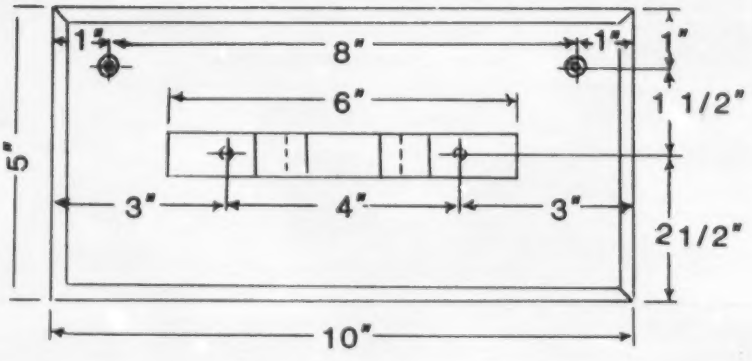
ISOMETRIC




BOTTOM VIEW

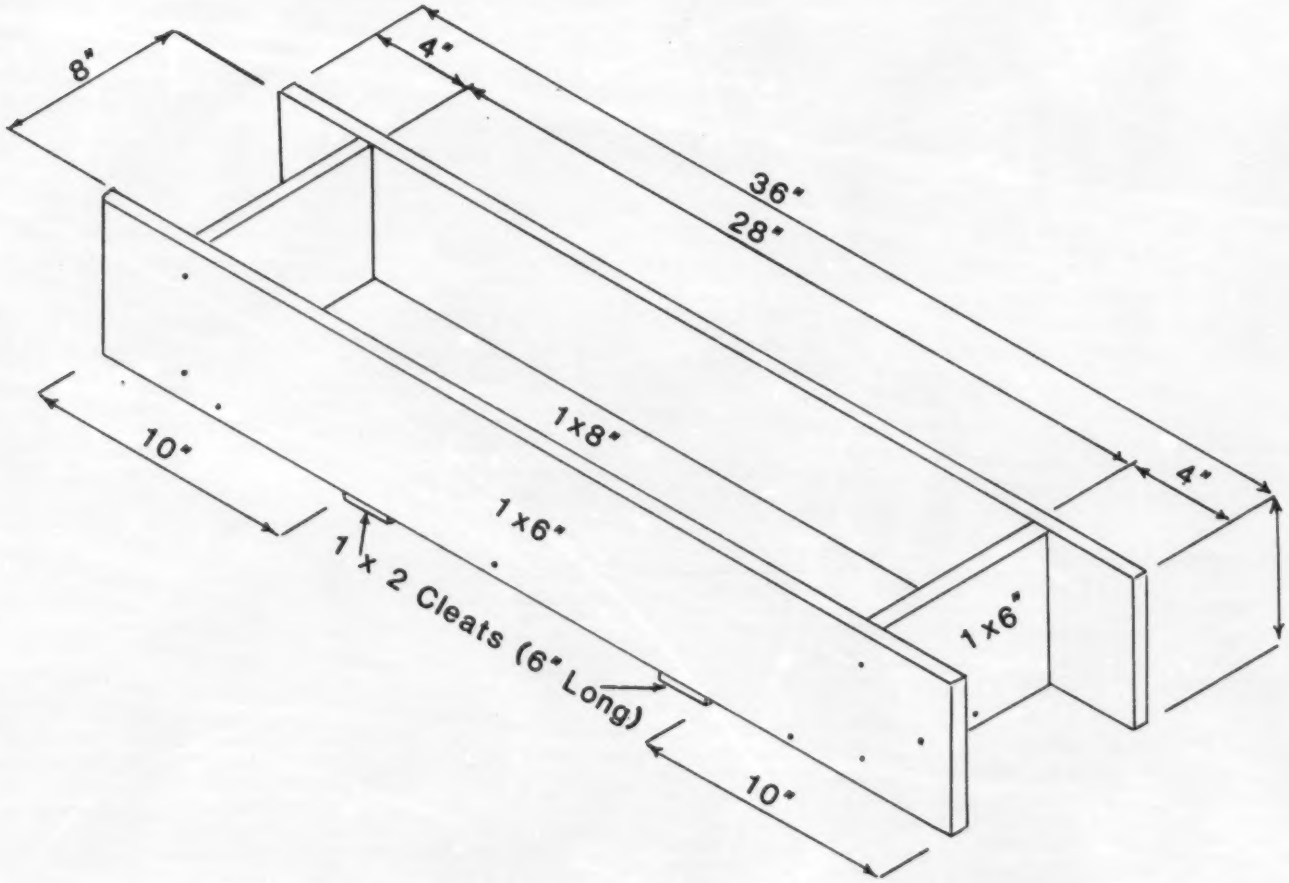



SIDE VIEW




FRONT VIEW

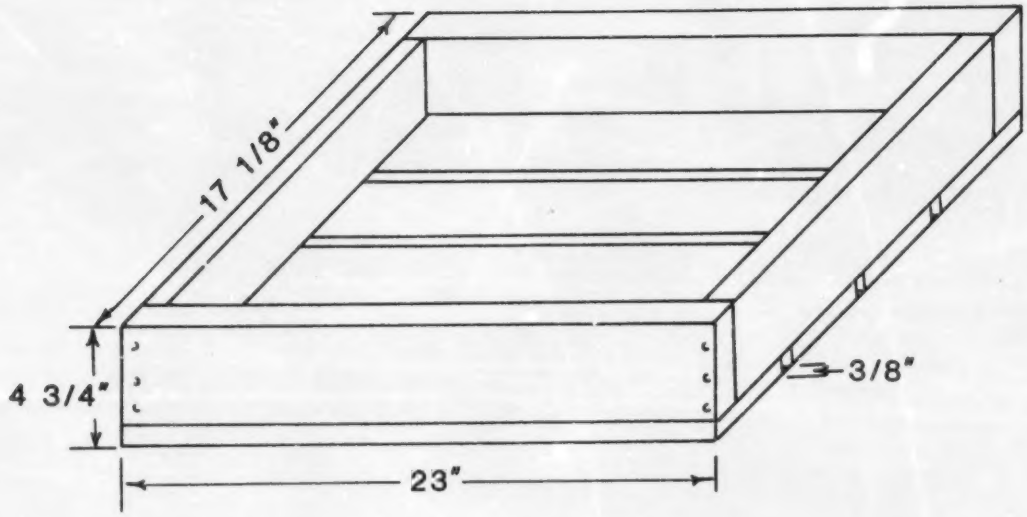
# PLANTER BOX




I-H-4-11

AGRICULTURAL MECHANICS PROJECT

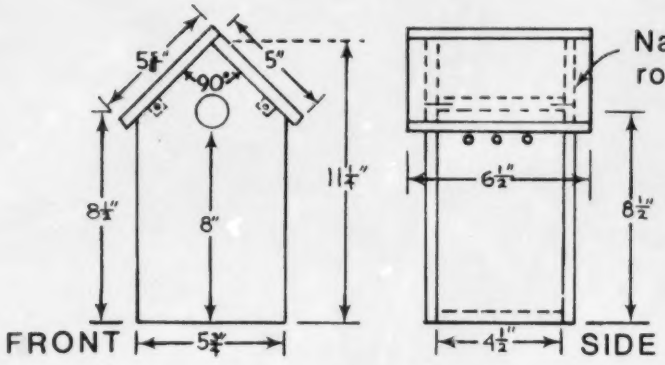
## Constructing a Flat

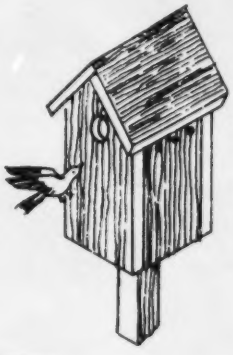


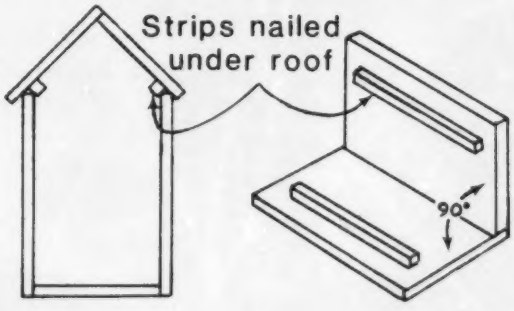

Bill of materials: (Use redwood stock.)

| Item | No. of Pieces | Size |
|---|---|---|
| Ends | 2 | 3/4" x 4" x 23" |
| Bottom | 4 | 1/2" x 4" x 23" |
| Sides | 2 | 1/2" x 4" x 15 5/8" |
| Nails | 1/4 lb. | 4d or 6d |

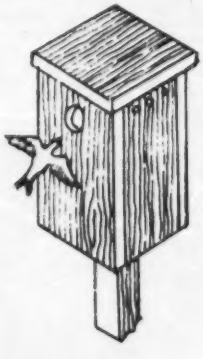
## Gable roofed birdhouse

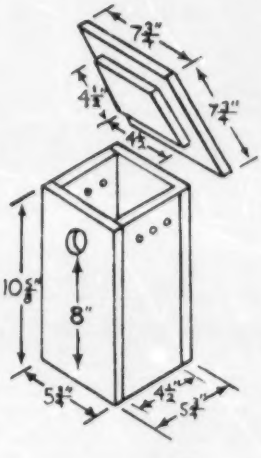





## Simple birdhouse





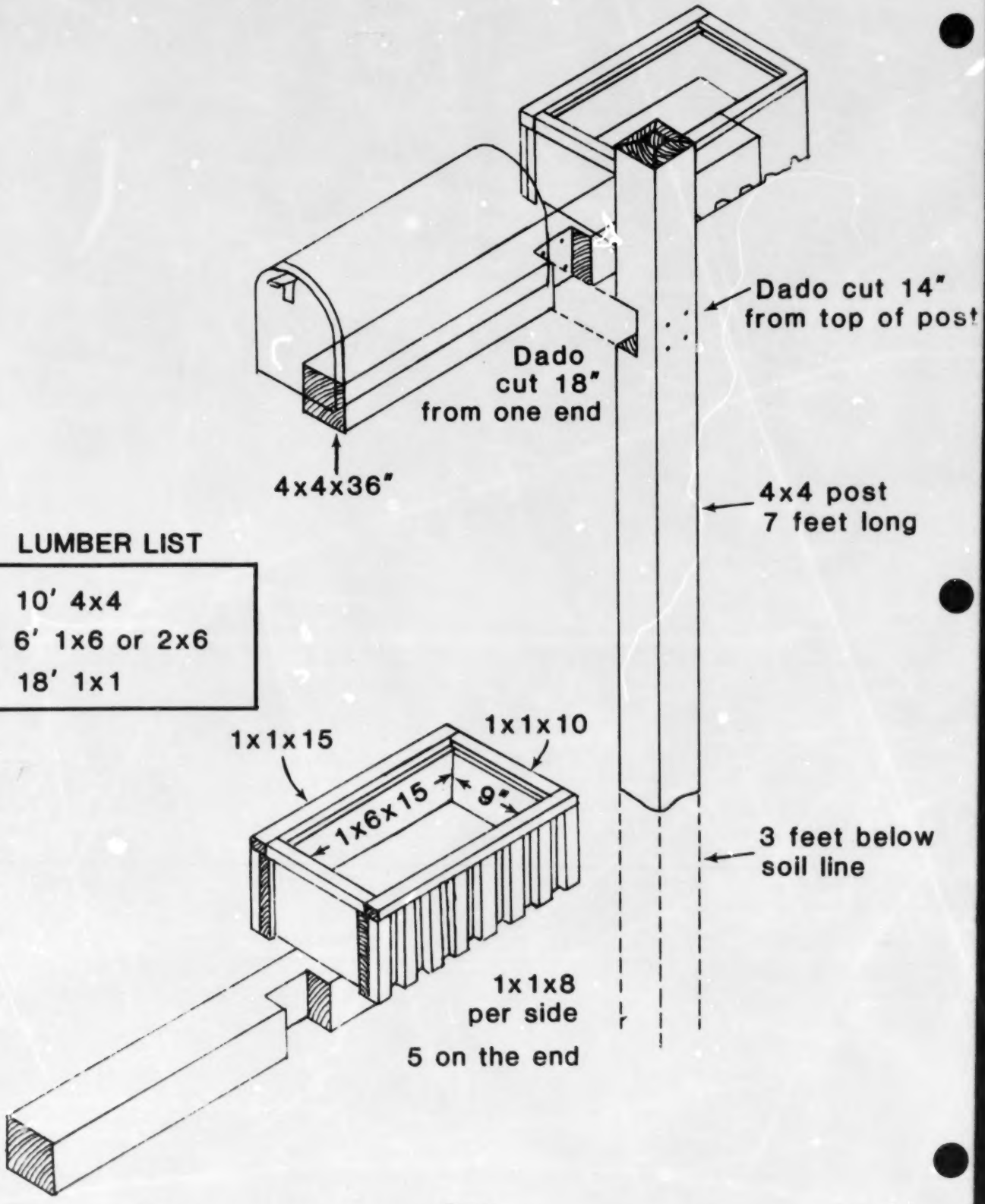

### MATERIALS

5/8 in. of plywood
1 – 1" x 6" x 5'
2 – 3/4" x 3/4" x 4 1/2" strips
– 4d nails (non corroding)

### TABLE OF DIMENSIONS

| | Diameter of entrance (inches) | Height from ground (feet) |
|---|---|---|
| Wren | 1 | 8–18 |

# MAILBOX PLANTER



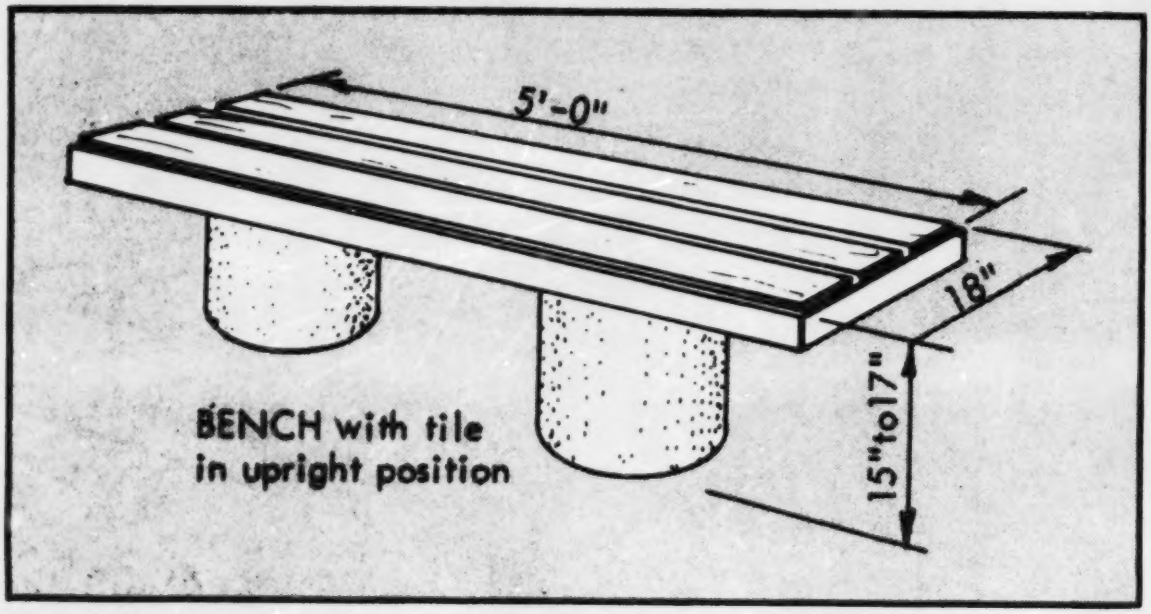

**LUMBER LIST**

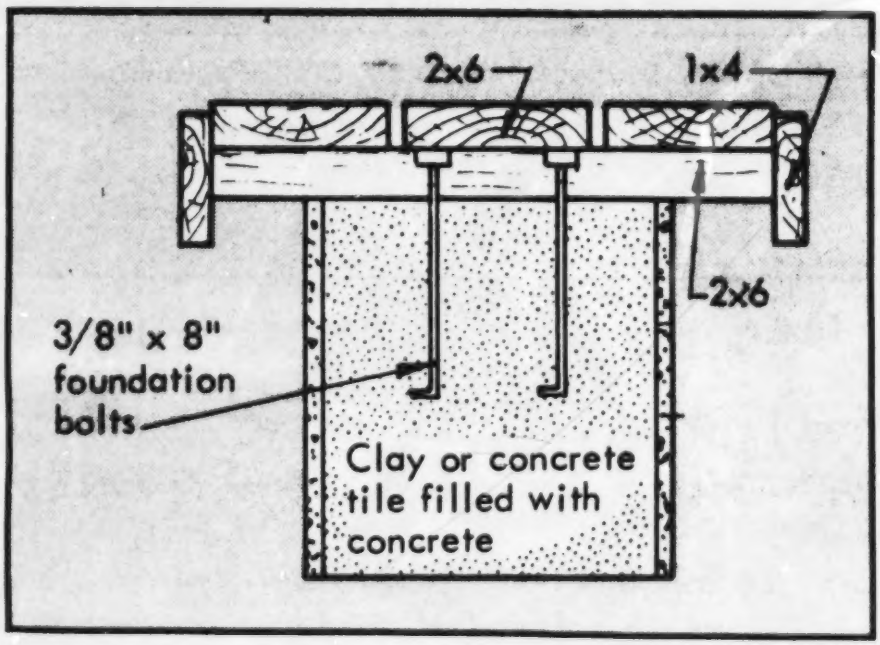
| |
|---|
| 1 10' 4x4 |
| 1 6' 1x6 or 2x6 |
| 1 18' 1x1 |



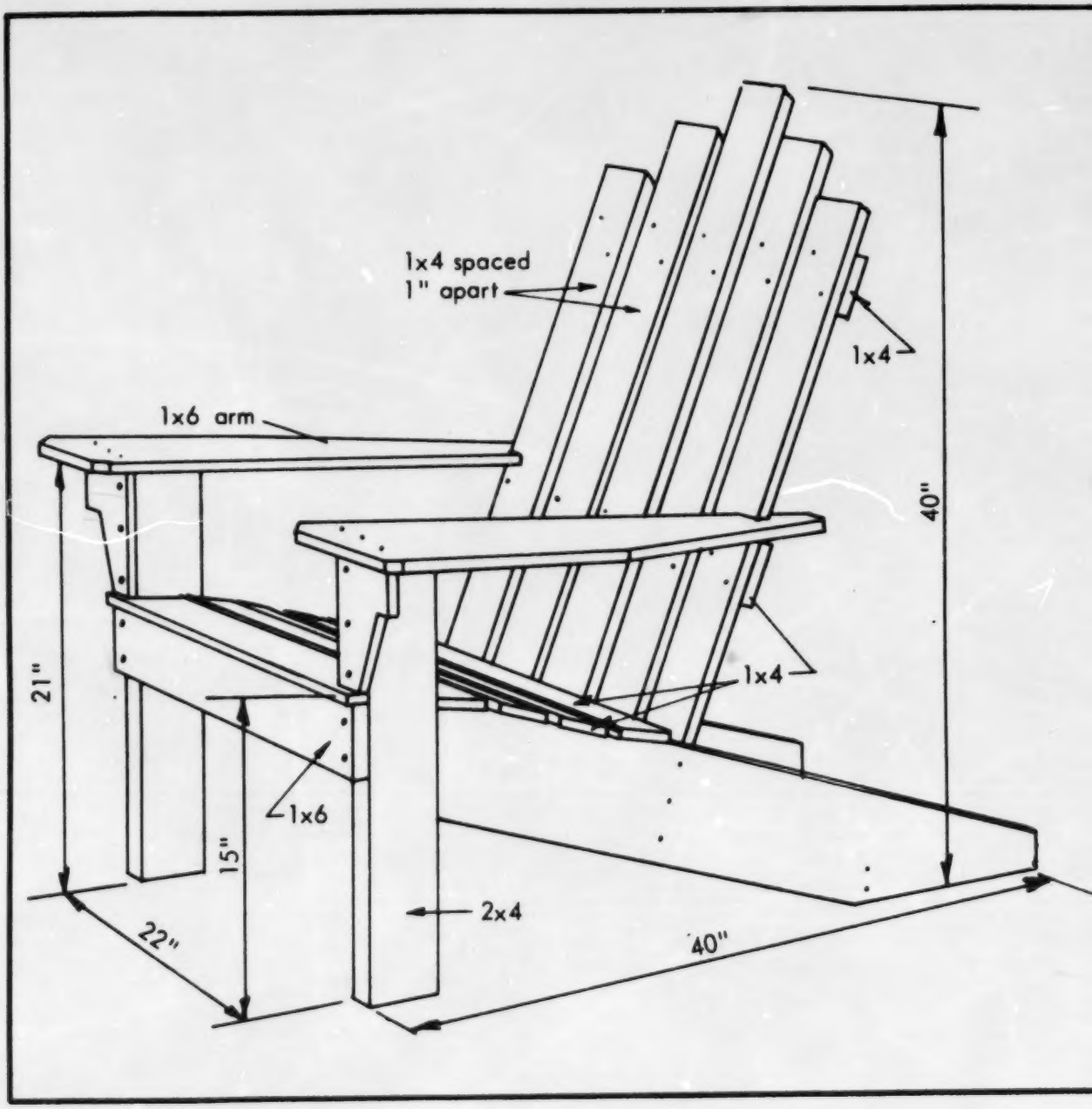
I-H-4-14

# Lumber and Tile Bench

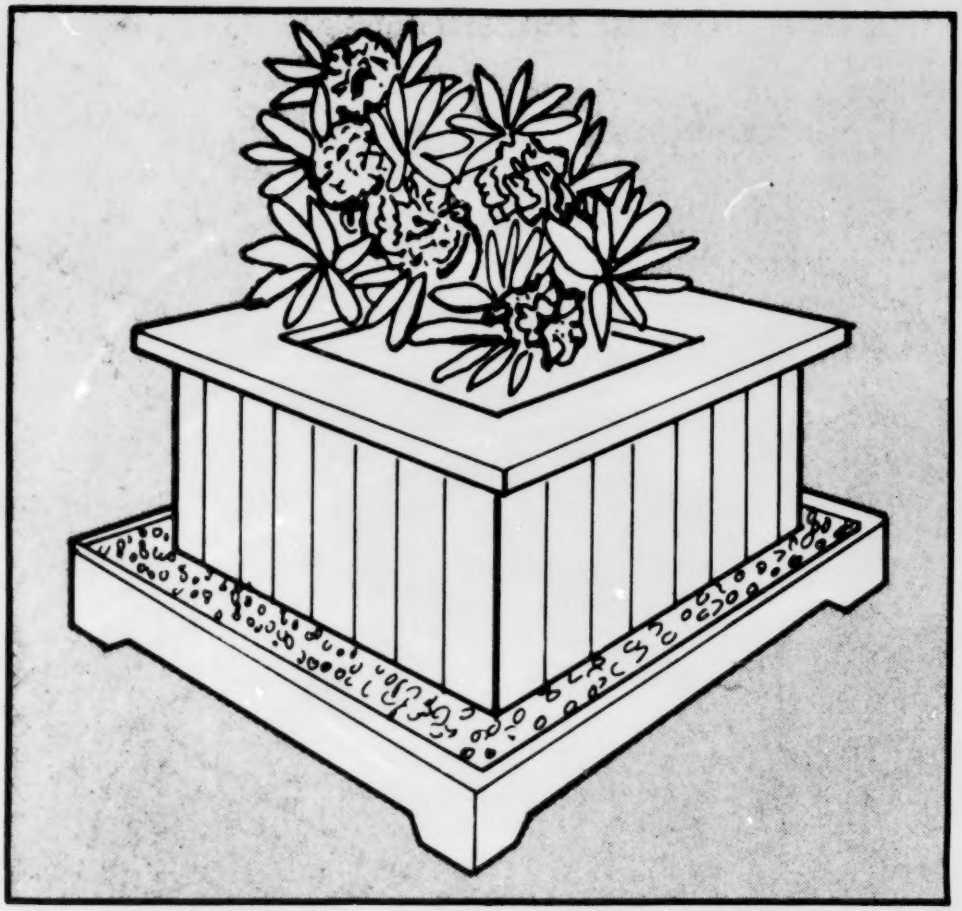


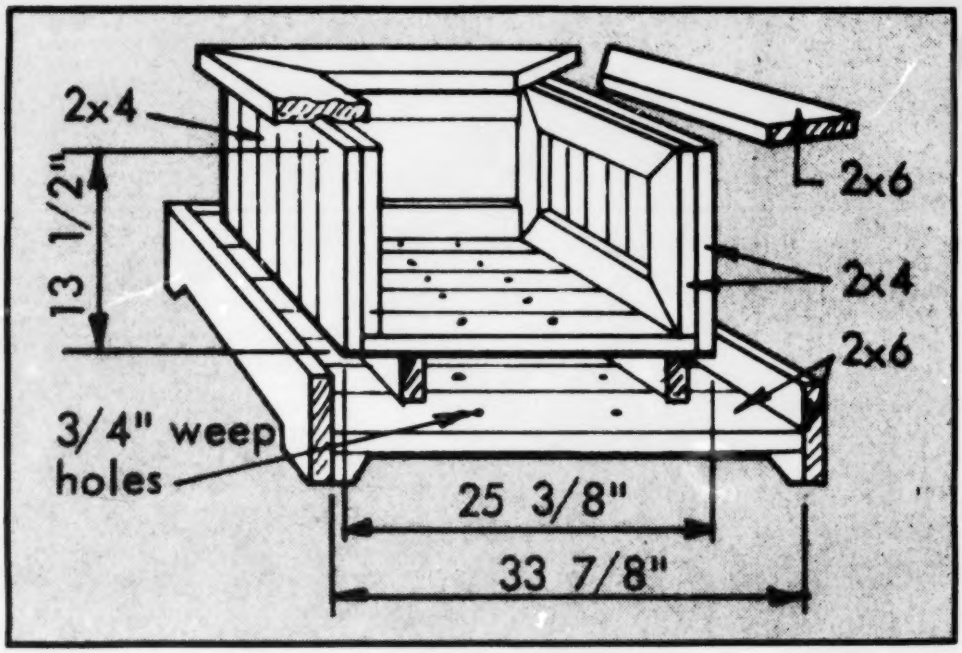



# Lawn Chair

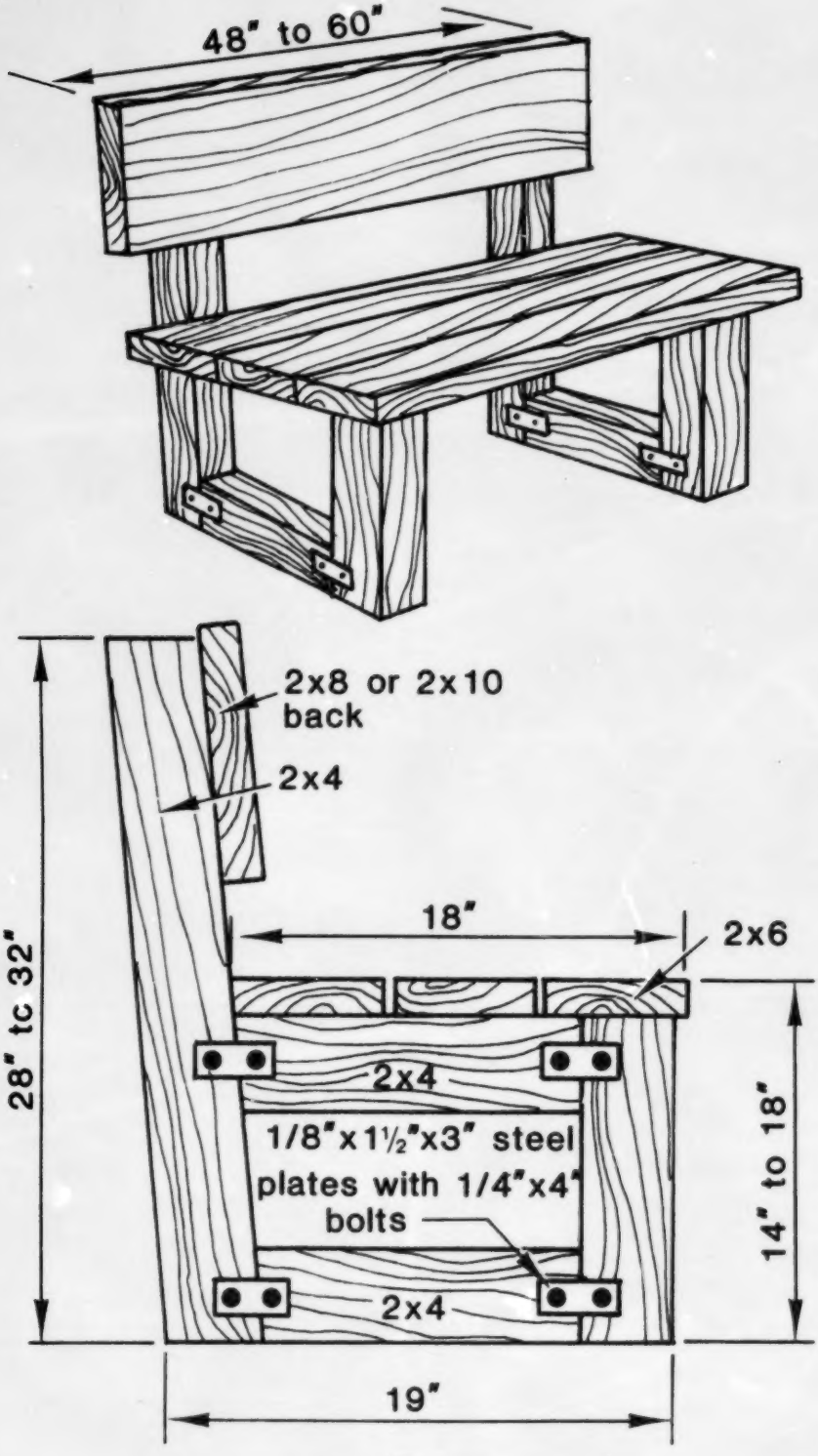


# Planter Box with Gravel Tray





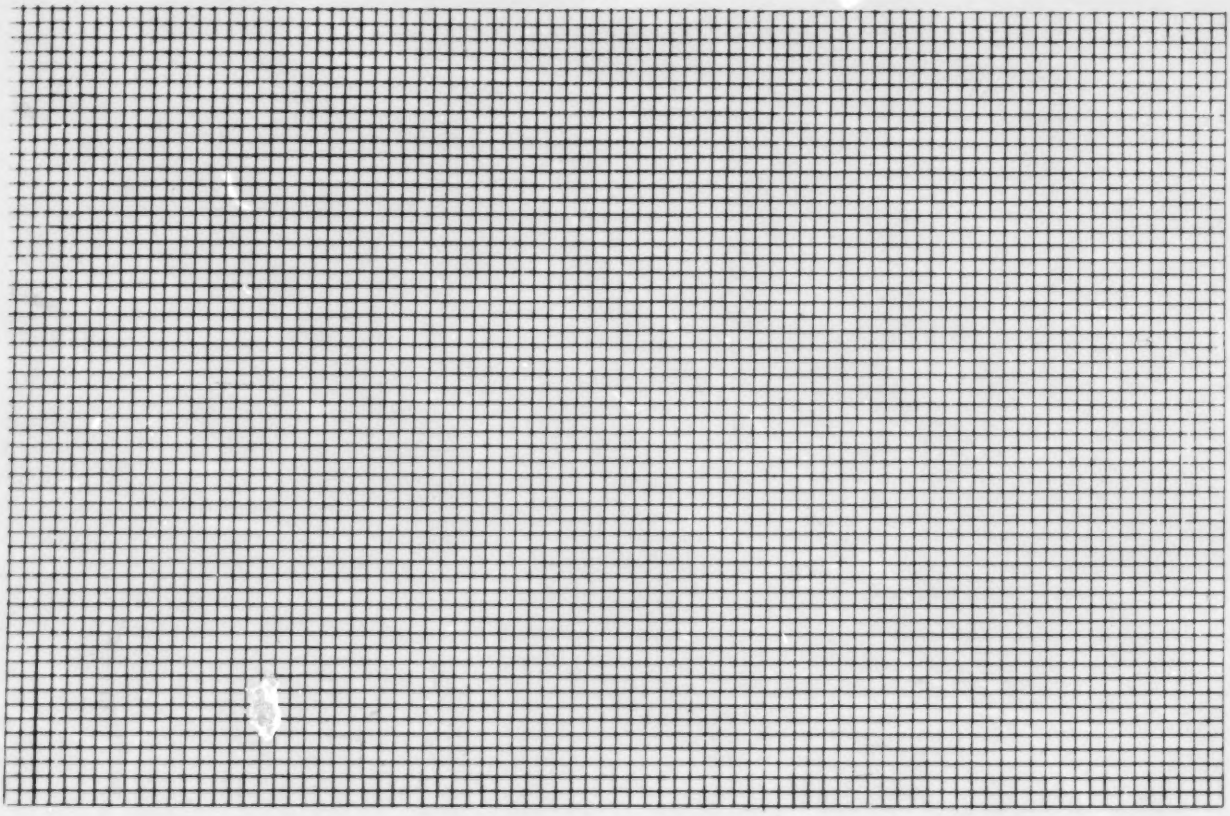
# Patio Bench


48" to 60"
2x8 or 2x10
back
2x4
28" to 32"
18"
2x6
2x4
1/8"x1½"x3" steel
plates with 1/4"x4"
bolts
2x4
14" to 18"
19"

# PROJECT PLAN

Name _____ Project _____

Drawings of the project (top, front, and/or side views). Attach photographs, blueprints, etc. if available.



Where did you get the ideas to plan this project _____

_____

## CUTTING LIST

| Number | Sizes Needed | Purchased dimensions | Use |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
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| | | | |

## BILL OF MATERIALS

**Lumber**

| Number | Dimensions | Grade and Species of Wood | Use | Cost |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
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| | | | | |
| | | | | |

**Fasteners**

| Number | Size | Kind of Fastener | Cost |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**Hardware**

| Number | Size | Kind of Hardware | Cost |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**Finish**

| Number | Size of Container | Kind of Finish | Cost |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |



TOTAL

## CONSTRUCTION PROCEDURE

(Steps in making the Project)

# AGRICULTURE MECHANICS DAILY PERFORMANCE REPORT

Name_____ Date_____

I. Problem Area (project)_____

A. Job skill performed today: Circle One

1. _____ individual or group
2. _____ individual or group
3. _____ individual or group

B. Difficulties encountered today:

1. _____ unsolved or solved
2. _____ unsolved or solved
3. _____ unsolved or solved

C. Plans for tomorrow:

1. _____
2. _____

D. Today I feel I accomplished the following grade:

Circle one – A B C D F

..... cutting line. .....

# AGRICULTURE MECHANICS DAILY PERFORMANCE REPORT

Name_____ Date_____

I. Problem Area (project)_____

A. Job skill performed today: Circle One

1. _____ individual or group
2. _____ individual or group
3. _____ individual or group

B. Difficulties encountered today:

1. _____ unsolved or solved
2. _____ unsolved or solved
3. _____ unsolved or solved

C. Plans for tomorrow:

1. _____
2. _____

D. Today I feel I accomplished the following grade:

Circle one – A B C D F

## STUDENT EVALUATION

(To be filled out when project is completed)

Name _____ Project _____

What do you like about your finished project? _____

_____

_____

How could you have done a better job? _____

_____

_____

What would you change if you were going to make another project like this one _____

_____

_____

What grade do you feel you deserve for this project? _____

## INSTRUCTOR EVALUATION

(Based on planning, use of time, and quality of workmanship)

How well was project planned: (drawings, cutting list, bill of materials, and contruction procedure) _____

_____

_____

_____

_____

Did the student make good use of shop time? _____

_____

Does the finished project show quality workmanship? (Is it square? Is it level? etc.) _____

_____

_____

_____

How could the project be improved? _____

_____

_____

_____

Project Grade _____

**TEACHER'S KEY**
**SUGGESTED TEST QUESTIONS**

## DEVELOPING BASIC CARPENTRY SKILLS

**Completion Section**

1. Two main classes of trees are the needleleaf or softwood and the broadleaf or hardwood.
2. Wood from the inner part of a limb or trunk of a tree is called heartwood and wood from the outer portion is called sapwood.
3. A defect in a board which is actually the cross section of a limb is called a knot.
4. Two general grades of softwoods are select and common.
5. Four types of lumber commonly used in agricultural construction are dimension lumber, common boards, finish lumber and pattern lumber.
6. Finish nails are used wherever you do not want nail heads showing in the completed project.
7. Nails will be less likely to bend if you lubricate the point with soap, wax or oil.
8. To prevent marring project wood when pulling a bent nail, place a wood block under the claws of the hammer.
9. A six penny nail (6d) is two inches long.
10. Box nails are smaller in diameter than common nails.
11. Three commonly shaped screw heads are oval, flat, and round.
12. Carriage bolts have a round head.
13. Stove bolts have a flat or round head.
14. A properly glued wood joint is stronger than the wood itself.
15. To hold two boards together while the glue is drying, use clamps if possible.

**True–False Section**

T 1. Driving a series of nails in a straight line parallel to the grain may cause splitting.

T 2. Screws hold wood more securely than nails.

F 3. Screws are usually cheaper than nails.

T 4. If you buy a 2" x 4" finished piece at the lumber yard you will find that it measures about 1 5/8 x 3 1/2.

F 5. When drilling a hole for a wood screw, you should drill a hole equal to the diameter of the screw.

T 6. Cedar wood is resistant to decay.

F 7. Oak is very easy to work.

T 8. A board 1" x 12' x 12' contains 144 board feet.

F 9. A 6d (six penny) nail is 6" long.

T 10. Stove bolts are threaded their full length.

**Classification Item**

1. Classify the following woods as hard or soft by checking the appropriate blank:

| Wood | Hard | Soft |
|---|---|---|
| Oak | X | |
| Elm | X | |
| White Pine | | X |
| Cedar | | X |
| Maple | X | |
| Redwood | | X |
| Walnut | X | |
| Ash | X | |
| Douglas Fir | | X |
| Cypress | | X |
| Hickory | X | |

**Multiple-Choice Section**

b 1. A board one inch thick, six inches wide, and sixteen feet long equals

a. four board feet
b. eight board feet
c. sixteen board feet

a 2. The symbol for lumber surfaced on one side is

a. S1S
b. S2S
c. S1E
d. S2E

**Multiple-Choice Section** (cont.)

d 3. Machine bolts have

a. Square holes
b. Hexagonal heads
c. Round heads
d. Square or hexagonal heads

b 4. Two pieces of wood glued together with a good glue form a bond that is

a. Weaker than when nailed
b. Stronger than when nailed
c. The same as a nailed bond

b 5. The length of an eight penny nail is

a. 8"
b. 2½"
c. 2"